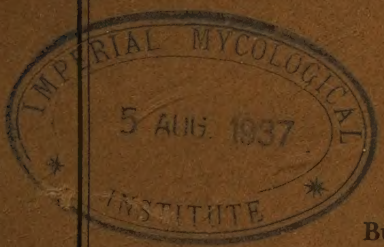
FORTY-NINTH ANNUAL REPORT

OF THE

Agricultural Experiment Station

OF THE

UNIVERSITY OF KENTUCKY



PART II

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LEXINGTON

1936

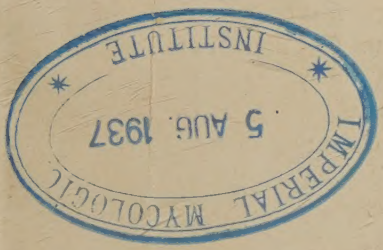
Agricultural Experiment Station

of the

UNIVERSITY OF KENTUCKY

FORTY-NINTH ANNUAL REPORT

For the Year 1936



Part I

Report of the Director

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LEXINGTON, KENTUCKY

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LETTER OF TRANSMITTAL

To His Excellency, Hon. A. B. Chandler, Governor of Kentucky:

Sir: In accordance with an act of Congress, approved March 2, 1887, entitled, "An Act to establish Agricultural Experiment Stations, in connection with the Agricultural Colleges established in the several states under the provisions of an act approved July 2, 1862, and under the acts supplementary thereto," and of the act of the Legislature of the State of Kentucky, approved February 20, 1888, entitled, "An Act to accept the provisions of an act passed by the Congress of the United States, approved March 2, 1887, for the establishment and maintenance of Agricultural Experiment Stations in connection with Agricultural Colleges established by the several states and territories under an act of Congress approved July 2, 1862," I herewith submit the Forty-ninth Annual Report of the Kentucky Agricultural Experiment Station.

Very respectfully,

THOMAS P. COOPER, *Director*

January 1, 1937.

ANNUAL REPORT

of the

DIRECTOR OF THE KENTUCKY AGRICULTURAL EXPERMENT STATION

For the Year 1936

The year was one of great activity; the volume of work increased; demands for investigation and service multiplied; changing conditions confronting agriculture and changing demands of consumers required studies looking to future readjustments. Thru its investigations, the Experiment Station attempts to give information as to trends and as to how this information may be used. Many studies were conducted in cooperation with various governmental agencies. Often these were of the administrative research type having for their purpose the determination of facts and trends for use in the effective planning and execution of agricultural programs.

Previous reports have referred to the crowded condition of offices and laboratories. Progress was made during the year in providing more working space. An addition to the Experiment Station building is under construction. This wing will provide 32 additional offices and more than 5,000 square feet of floor space for mailing room, supply room and certain service uses. Provision is made in the addition for increased library space and for an adequate conference room. Other construction includes a laboratory especially designed and equipped for studies in tobacco, and tobacco curing, and in connection therewith a greenhouse with 1,920 square feet of space; also a greenhouse with 540 square feet of space for use in studies carried on by the chemistry department. At the Western Kentucky Substation a tobacco barn designed for experiments in firing dark tobacco has been erected.

There continues to be need for additional space. The research work in animal pathology has outgrown the quarters

assigned for it, and a new building should be provided at an early date.

A far-reaching program of scientific investigation concerning tobacco has been undertaken. A committee was appointed to coordinate the tobacco investigations, and arrange for the necessary cooperation among the various departments. Twenty-one projects on tobacco are in progress covering production, disease control, curing, marketing, the development of new varieties and strains, etc. The greater part of this work has been centralized under the Bankhead-Jones funds.

Some three years ago a study was undertaken to investigate the possibilities of developing new uses for tobacco by-products, and to ascertain if commercial products could be obtained from unmarketable grades of tobacco. From this investigation a new use for nicotine has been found which should be of great value to horticulturists and gardeners. It was found that atomized oil-nicotine spray could be safely applied to plants with a high percentage of destruction of insects. Oil-nicotine spray can be prepared in two ways for field and greenhouse use. The spray must be applied in the form of a fine mist or fog to avoid foliage injury. Also, types of effective spray nozzles and a hand atomizer have been devised.

Seed was distributed in 1935 of a disease-resistant strain of burley tobacco known as No. 16, which was developed by the Experiment Station. This particular strain of tobacco was favorably received and promises to become one of the leading strains used by farmers in the state.

A laboratory has been fitted up at the Western Kentucky Substation, for the study of blackfire and other leafspot diseases of dark tobacco. A member of the research staff has been assigned to the Western Kentucky Substation to carry on these studies. Provision has been made, also, for further research and experiments as to methods of curing dark tobacco.

The agreement was continued with the Tennessee Valley Authority for the conduct of experimental work in soils, particularly as affected by the use of phosphates. These investigations are supplemental to those which have been carried on by the Experiment Station for the past 20 years with refer-

ence to the use of phosphate and of limestone. It was possible to increase the number of tests made. The results remain similar to those originally reported. Tests were made of 7 different kinds of phosphate. These were applied on 1,155 plots located at 11 different places in the state. The determination of the effect of top-dressing pastures required the use of 104 plots in 6 different locations in the state. In general, the new types of phosphate showed varying degrees of availability, but all sufficient to make these products of great value for Kentucky soils.

Close relationship was maintained between the activities and investigations of the Experiment Station and many of the cooperative functions which are being carried by governmental agencies in the state. From time to time, arrangement was made for special research or for the use of the results from regular research which might be useful to governmental agencies in furthering the progress of work which they had undertaken in the state. It was necessary to assign members of the research staff for indefinite periods of time to the soil conservation program and to give frequent advice with reference to other types of programs. It is the purpose to adjust as far as possible the resources of the institution so that the major research activities in which farmers of the state are interested shall not be affected by the emergency investigations that may be required.

The varied activities of the Experiment Station are presented briefly in this report. Results of work and detailed reports of the research projects are set forth in 7 bulletins, 42 scientific papers, and in other miscellaneous publications which were issued during the year.

Analysis of Tobacco Prices. The price per pound of burley tobacco, when adjusted for changes in the general price level, tended to rise gradually during the past thirty-five years. This was due to two factors; first, a world-wide shift in consumer preference from chewing tobacco and cigars to cigarettes and light smoking tobacco; and second, a gradual change in the type of burley grown to meet the change in demand. As burley tobacco prices trend upward, there is a tendency toward considerable fluctuation. High prices reoccurred at intervals of from four to six years. Peak prices,

relative to other products, were reached in 1908, 1912, 1918, 1922, 1928, 1932 and 1936.

Geographical Variation in Tobacco Prices. The tabulation of prices obtained for tobacco grown in 561 communities of 72 burley-growing counties, 133 communities in 17 fire-cured tobacco counties, and 104 communities in 14 dark air-cured tobacco counties, shows a large variation between localities. Information was obtained from all markets of these areas. Differences in cents per pound are wider for burley tobacco but percentage differences seem equally great for the dark air-cured and fire-cured types. Differences in price may be partially explained by differences in soil, marketing facilities and other factors at present unascertained in this study.

Prices Paid by Farmers for Commodities Purchased. This project was conducted in cooperation with the Bureau of Agricultural Economics in order to get sufficient data to establish indexes of the purchasing power of farm income. Data were gathered relative to the prices of articles purchased by farmers, particularly during the period 1909 to 1914, inclusive. A total of 191 schedules of prices or service rates were obtained from merchants, dealers, dentists and others, in 35 counties of the state. Fertilizer and feed prices were tabulated from Experiment Station records and prices of other commodities were taken from newspaper quotations. Preliminary tabulations indicate that prices paid by farmers for most articles remained relatively constant thruout the six-year pre-war period. Prices in different parts of the state appear to have been surprisingly uniform during the period.

Farm Business Analysis Study. In connection with the various livestock enterprises, 127 farm business surveys were made, 50 of which were in the Inner Bluegrass region, 37 in Union county, 26 in Owen county and 14 in Meade county.

In Union county the practices which led to higher net earnings were the maintenance of soil fertility; control of erosion; providing feed at relatively low cost by seeding small grain in the fall on land which had been summer tilled; improved pastures and feeding the farm-produced hay and corn on the farm, making it possible to carry more livestock. The more rapid fattening of hogs by the use of a protein-rich supple-

ment and the practice of swine sanitation, resulted in higher income per sow and a larger net profit per farm.

The 50 Inner Bluegrass region farms averaged $2,749 net earnings for the operator of each farm, in 1935. A comparison of the 15 most profitable farms with the 15 least profitable farms showed that the operators who made the greater profits grew a larger acreage of tobacco and a smaller acreage of corn per farm; had a larger proportion of the tillable land in harvested crops; made higher crop yields, and produced tobacco by owner operation. There were more cattle and sheep on the more profitable farms than on the others.

Rural Population and Community Studies. Twelve school districts in the Eden Shale area of Anderson county were selected for study of factors in the migration of young persons from this county. The schools were one-room buildings, and the area one of typical hill-farms. The topography is rough; the farm operators' earnings averaged approximately $600 a year and were adequate only when thrift was practiced. The names and ages of all persons aged 6 to 19 years who lived in these districts 20 years ago were obtained from the 1916 State school census. Three groups of four districts each were formed: group A, along the border of the county and farthest removed from a state highway; group B, intermediate; and group C, along the state highway. The present places of residence of about 300 males and 225 females were tabulated.

The facts seem to indicate that a land-use policy in an area such as this must be based on the expectation that about one-third of the native youth may go into nearby better-soil areas, one-third remain in the home area, and the others migrate to more distant places inside and outside Kentucky. The present index of natural increase for the farm population in Anderson and other similar Eden Shale counties is 125 to 150. With an excess of only 25 to 50 percent and an emigration of more than 60 percent of the population, there is much opportunity for land-use adjustments.

The findings are of significance to the local and state school administrators. They suggest that where vocational agriculture is taught it should at least compare farm practices in hill areas with those in the Outer and Inner Bluegrass, because as many youths leave this area to farm elsewhere as

remain to farm in this area. The facts suggest that training in stenography, industrial arts and transportation mechanics are as useful to the farm-reared youth of this area as training in vocational agriculture.

Farm Tax Delinquency. An indication of the improved economical status of Kentucky farms is shown in the present tendency for tax-delinquent farms to be smaller and of less value than in the years of the depression.

A project was organized in cooperation with the Bureau of Agricultural Economics, United States Department of Agriculture, to determine from careful studies, (1) sales and transfers of farm land, (2) mortgages secured by farm land, and (3) real estate taxes paid on representative farms. These data were collected in 35 counties, covering periods from 1890 thru 1912, and from 1934 to 1935, inclusive. It is anticipated that this material will be useful in connection with the development of agricultural programs, and in furnishing the basis of fact for interpreting what has occurred in agriculture over a period of years.

Farm Organization and Management in Central Kentucky Hill Region. The Eden Shale area is one of the largest and most important agricultural areas in Kentucky. Of high original fertility, the land has suffered from erosion to a marked degree. Farm population in the area has decreased 25 to 50 percent since 1880. In the area are parts of 16 counties, as follows: Anderson, Boyle, Clark, Franklin, Garrard, Grant, Harrison, Henry, Madison, Mercer, Montgomery, Nicholas, Pendleton, Robertson, Shelby and Owen. It was considered desirable to study farm organization and management in this area because of its importance from the standpoint of population and the number of farms.

Data on farm management, family incomes, land use, and soil conservation practices were obtained from 200 farmers in Anderson, Garrard, Mercer and Washington counties. Similar data were obtained from 152 farms in Robertson county, and from 92 farms in Fleming, Mason and Nelson counties, in the areas adjoining the outer Bluegrass region.

Information was obtained relative to length of rotation necessary to control erosion on the different types of soil; seeding practices including seeding mixtures used by the most suc-

cessful farmers; crop sequence including time of seeding in rotation; cultural practices for controlling erosion on steep slopes; engineering practices to control erosion on steep slopes; livestock enterprises that utilize feed and pasture adapted to these farms; optimum size of farms adapted to the type of farming; sources of cash income by size and type of farming; farm organization and management practices that maintain the soil and provide profitable returns; migration data from sample areas indicating population trends.

Farm Management and Soil Conservation in Southern Logan County. This study was made in cooperation with the Agricultural Adjustment Administration, the Bureau of Agricultural Economics and the Soil Conservation Service of the U. S. Department of Agriculture. It was conducted in a type-of-farming sub-area representative of naturally fertile agricultural land, level to rolling for the most part, aggregating more than one million acres. Records on business analysis, farm income, and soil conservation practices and costs were obtained on 167 farms. An analysis of the amount of erosion on 93 representative farms was made.

The 15 farms showing the least erosion were compared with the 15 showing the most. A net loss of about one-third of the top soil had taken place in the former group, and about three-fourths in the latter. The least eroded averaged 30 acres more per farm than the most eroded. The least eroded farms averaged larger yields of crops; corn averaged 28 bushels per acre, wheat 3 bushels and tobacco 349 pounds per acre more than on the badly eroded farms. Operators of the 15 least eroded farms earned labor incomes averaging $536 more per farm than the 15 operators of the most eroded farms.

In 1935, thirty percent more of the intertilled crop land of the least eroded farms was covered with a growing crop the following winter. One-third of the most eroded farms had no cover crops in the fall and winter of 1935. Fifty-four percent of the farmers operating the least eroded farms used limestone to improve the soil, while only 27 percent of those operating the most eroded farms used limestone. Fertilizer was used for wheat on all the least eroded farms, and for tobacco on 87 percent of them.

Milk Production Costs and Returns. This study of the unit requirements, costs, returns, and management practices influencing profits was made with twenty-eight dairy herds, 16 of which were in the Bowling Green area, 8 in the Inner Bluegrass region and 4 in the Louisville area. These records and similar records for the past 5 years show that feed and pasture account for about two-thirds of the gross cost of milk production, and labor about one-fifth. They also indicate that dairymen may lower costs by feeding grain in accordance with production, and by using more pasturage, thereby shortening the time during which concentrates and roughage must be fed.

Milk Marketing. Milk marketing problems in Lexington are largely local in character. The greater part of the milk for the Lexington market is produced within a radius of 36 miles from the city. In 1935, sixty-two percent of the cows supplying the market were within eight miles of the center of the city and eighty-six percent were within 16 miles. The proximity of the producers to their market encourages producer distribution and private hauling. Fifty-six percent of the dairymen who sold raw milk and forty-one percent of those who shipped to plants had sold milk consistently for six years or more, but farmers in general are not dairy-minded and tend to shift in and out of milk production as other enterprises become relatively more or less profitable.

Milk production is closely associated with a grass-land economy. Peak production occurs in May when pastures are at their best. The milk supply at this time is about fifty percent more than at the time of the production low which occurs between December and February. Seasonal production and mal-distribution of supplies within the market are decidedly unsettling factors.

The 1932-35 average milk production for the Lexington market was about seventeen and a half million pounds annually. About sixty percent of this was sold as whole milk, one percent as chocolate milk and fourteen percent as cream. Skim-milk from about fifteen percent of the total supply was sold as buttermilk and three percent as cottage cheese. The remainder was used for butter, ice cream mix or otherwise. One quart of buttermilk was sold for every three quarts of

sweet milk. Much of the demand for buttermilk was from sections of the city inhabited by people of low income.

In Lexington, the per capita consumption of sweet milk and milk equivalents, including buttermilk, is about 0.56 pint per day. This is low compared with 1.6 pints for Boston, 1.05 pints for Minneapolis, and 0.82 pint for the United States as a whole.

Livestock Marketing. A study was made in selected areas within a hundred miles of the Cincinnati market to determine the attitude of livestock producers toward existing marketing agencies. General farming is practiced in most of the area but livestock production is on a relatively small scale and the number of livestock per farm is such as to discourage full carload or full truck load marketing. The consensus of opinion expressed by the livestock producers interviewed favored the continuation of present market agencies under regulations which would maintain and develop fair marketing practices.

Lamb Production Costs and Returns. Unit requirements, costs, returns and flock management practices were studied in 111 flocks, 39 in Owen and Grant counties, 34 in the inner Bluegrass region, 22 in Washington county and 16 in Meade county. In general, the farmers with the lower costs raised a larger number of lambs for each 100 ewes, by culling and replacing the ewes to keep a thrifty, vigorous flock 2 to 5 years of age. Death loss of ewes was less in these flocks. Selling most of the lambs by the first of August proved profitable because the price was higher earlier in the season, parasitic infestation was largely avoided, and the early lambs had better pasture and cooler weather, resulting in more economical gains.

Hog Production Costs and Returns. These studies of 40 herds of hogs, 24 in Union county and 16 in the inner Bluegrass region, showed that the systems of feeding and management that produced finishing hogs in the shortest time and in accord with market demands, resulted in greatest net returns. The time required to raise a 200-pound hog was influenced by the amounts of carbonaceous and protein-rich concentrates used, and the maintenance of practices which keep the hog healthy vigorous and free from parasites. The two periods most favorable for selling hogs at the highest price are Feb-

ruary 15 to April 15, and July 15 to September 15, according to a study of the market for the past five years.

Turkey Incubation Studies. Incubation studies were made with over seven thousand turkey eggs varying in weight from 2 to 4½ ounces. Good hatches were had from eggs of all sizes and there was no relationship between egg size and hatch. A total of 775 poults hatched from eggs of different sizes were observed during the early brooding stages to determine if any relationship existed between the viability of poults and the size of eggs from which they were hatched. The mortality during the first 30 days was quite low in all groups hatched from eggs that weighed between 2.6 and 3.5 ounces, whereas the mortality was noticeably higher among poults hatched from the abnormally small and excessively large eggs.

Protein Levels for Pullets. Pullets were grown on low, normal and high protein levels, using a mash and also grain, to determine the effect upon growth and subsequent egg production. As the protein level increased, the weight of the chicks at 12 weeks increased, but the weight at maturity showed little difference. The winter, and also the yearly, egg production indicated no advantage in stimulating early growth by additional protein above the normal.

At the Western Kentucky Substation, pullets were grown on mash mixtures of high and low protein content. The mash of the low protein pen contained no meat scrap, while meat scrap was added to the starting mash of the other pen. After the chicks were 3 months old, meat scrap and grain were hopper-fed to both lots. Skim-milk was fed *ad libitum* at first and only until 10 a. m. during the summer. The winter and yearly egg production indicated no apparent advantage in adding meat scrap to the starting mash, when the chicks received all the skim-milk they would consume. These results indicate that a high level of protein is not necessary in the starting mash provided sufficient animal protein is received from the third month to the laying age.

Kentucky Bluegrass as Source of Protein for Growing Chicks. Experiments conducted the past few years have shown that growing bluegrass, cut succulent bluegrass and bluegrass that has been dried indoors without direct irradiation by sunshine or mercury quartz arc do not contain measureable amounts of

vitamin D, nor was vitamin D imparted to succulent bluegrass by either form of irradiation. However, dried bluegrass irradiated directly by sunlight or a mercury quartz arc, for 20 minutes, contained vitamin D. Grazing animals receive vitamin D from direct sunshine, not from the bluegrass.

Lespedeza By-Products for Feeding Chickens. Low-grade lespedeza seed mixed with weed seed is a high-protein by-product from seed-cleaning plants. Tests of its value in poultry feeding were made with chicks and laying hens. With growing chicks, seed containing 41 percent protein, seed and screening containing 28 percent protein, and screenings containing 21.5 percent protein were compared. Steamed bone meal supplemented the lespedeza ration. On the basis of weight at 12 weeks, the results indicate that as much as three-fourths of the meat scrap may be replaced by ground lespedeza seed and screenings, with satisfactory results. Substitution of lespedeza screenings for only one-fourth of the meat scrap gave good results, but substitution for as much as one-half the meat scrap gave only fair results. In the tests with layers, the pullets were grown on a ration containing meat scrap and milk but no lespedeza products, and divided equally into 6 lots, at the start of the laying period. The control lot, pen 1, received 20 percent meat scrap and no lespedeza product; pen 2 had 15 percent meat scrap; pen 3 had 10 percent; pen 4, 5 percent and pen 5 no meat scrap. In pens 2, 3, 4 and 5, amounts of lespedeza seeds and screenings necessary to maintain the protein content of the mash were added. The results indicate that one-fourth to as high as one-half of the meat scrap in the laying mash may be replaced satisfactorily with lespedeza seed and screenings.

Experiments in feeding chicks on mashes containing leaf meals of alfalfa, Korean lespedeza and lespedeza sericea, indicate that the protein in these meals has the same biological value, and that it can replace half the protein of meat scrap better than the same amount of milk protein, in a normal chick ration.

Distillery By-Products for Feeding Chickens. The thick slop gave satisfactory results when used to replace as much as four-fifths of the corn in the growing mash. Good growth

was also obtained when two parts thick slop and one part dry mash, that is, all mash, were mixed and fed moist.

Cholesterol Content of Fresh and Storage Egg Yolk. Chemical analyses of egg yolks that were produced under controlled conditions, were continued to obtain more information as to their nutritive value. The cholesterol content of both fresh and storage egg yolks was determined. Eggs were collected from hens kept in three pairs of pens. The same basal ration was used in all pens. The hens in the first pair of pens were confined without sunshine; those in the second were confined but allowed to run out on a screened porch and so had exposure to sunshine; those in the third were allowed bluegrass range. The hens in one pen of each pair were given cod liver oil.

Cod liver oil added to the ration of hens that were exposed to sunshine or that had bluegrass range, did not increase the cholesterol content of the egg yolks, but did increase that of the yolks produced by hens without access to sunshine or bluegrass. Bluegrass seemed to have a greater effect in increasing the content of cholesterol in the egg yolk than does sunshine.

The analyses indicate that very little deterioration of cholesterol took place in the eggs that were produced by hens which were exposed to sunshine or to sunshine and bluegrass. Stored eggs from hens kept in confinement gave lower values than did the fresh eggs. Cod liver oil in the ration seemed to have little or no protective effect on cholesterol during storage.

Roughages for Breeding Ewes in Winter and Spring. Ten ewes fed lespedeza sericea hay lost 32 pounds in the first 28 days. In a similar feeding test, in 1935, 10 ewes lost 99 pounds in the first 28 days, and it was impossible to continue feeding the hay. Thirty percent of the hay was refused by the ewes in the 1936 trial as compared with 61 percent in 1935. Probably there was a difference in the quality of the hay fed in the two years.

Distillery Slop for Hogs. Four similar lots of hogs (Nos. 2-5) received approximately 2, 1½, 1 and ¾ bushels of shelled corn, respectively, to each barrel of slop. Another lot which received no slop served as a control. The slop was settled 24

to 36 hours and only the thicker or settled portion, which amounted to about 2 3 of the original volume, was fed. The results of the test show that as the proportion of corn to slop decreases, the carcasses produced tend to be softer.

Compared with the control, the amounts of corn and tankage saved for each 100 pounds of gain, by feeding the settled slop, were as follows: in lot 2, 98 gallons saved 35 pounds of corn; in lot 3, 114 gallons of slop saved 77 pounds of corn and 4.6 pounds of tankage; in lot 4, 157 gallons saved 101 pounds of corn and 1.4 pounds of tankage; in lot 5, 185 gallons saved 133 pounds of corn and 1.6 pounds of tankage.

Pasture for Hogs. Three lots of 20 pigs each, with an average initial weight of 51 pounds, were grazed on three separate pastures, (1) oats and rape, (2) bluegrass and (3) alfalfa, and fed three percent of their live weight in shelled corn daily. The average daily gains per pig and weights of shelled corn eaten, for 100 pounds gain, were: On oats and rape 0.30 pound gain and 539 pounds of corn; on bluegrass, 0.26 pound gain and 604 pounds of corn; on alfalfa, 0.43 pound gain and 375 pounds of corn.

In the second period, 10 pigs from each of the three lots were put into a new field of alfalfa, and 10 from each into a field of Korean lespedeza. The pigs in both lots received three percent of their live weight in shelled corn daily. The 30 pigs on alfalfa made an average daily gain of .86 pound a pig, and received 303 pounds of corn for every 100 pounds of gain. The 10 pigs transferred from the previous alfalfa plot made an average daily gain of .95 pounds per pig; the 10 from bluegrass an average daily gain of .76 pound and the 10 from oats and rape an average daily gain of .86 pound. The 30 pigs put on lespedeza gained .68 pounds each daily, and received 367 pounds of corn for every 100 pounds of gain. The average daily gain per pig for the 10 taken from alfalfa was .74 pound; of those from bluegrass .63 pound, and of those from oats and rape, .67 pound.

This is the third year of the experiment. In all three years, the pigs gained most on alfalfa, and distinctly less on Korean lespedeza, under otherwise similar conditions. The gain on lespedeza was similar to that on bluegrass.

Cottonseed Meal Versus Distillers' Dried Grains for Fattening

Steers. To compare distillers' dried grains with cottonseed meal as protein supplements in feeding steers, two lots of 5 steers each were fed for 114 days on like rations of corn, hay and silage. One lot received 2.4 pounds of distillers' dried grains per day, per head, and the other, 2.1 pounds of cottonseed meal. The first lot gained 2.36 pounds per head per day, and the other, 2.43 pounds. The difference is practically negligible.

Epizootic or Virus Abortion in Mares. An outbreak of abortion in a band of twenty mares, of which 12 aborted, was observed and studied in 1922. All these mares had been immunized against *Salmonella abortivo-equinus.* The agglutination test for Salmonella infection was negative and careful cultural search of all the aborted fetuses, the afterbirths and the uterine secretions of the mares did not reveal *Salmonella abortivo-equinus.* Since then at least 12 outbreaks have been encountered with a total of 125 abortions. In all these outbreaks every effort was made to isolate a causative microorganism, but in each instance cultural studies failed to reveal the presence of bacteria. However, it has been shown that the disease is transmissible by contact, by ingestion of material from aborted fetuses and afterbirths, and also by the use of materials which were passed thru filters impervious to ordinary bacteria. Not all the experimental cases gave positive results, but abortion was produced in a sufficient number to indicate that the disease is infectious and that the infectious agent is a filterable virus.

Tissue changes observed in the aborted fetuses and the condition of the afterbirths are decidedly distinct from those observed in cases of abortion due to other causes. The most characteristic and most consistent lesions are numerous small, grayish-white areas of degeneration in the liver. The liver appears somewhat enlarged, gorged with blood and of a dark, bluish color. Other tissue changes observed are the accumulation of serum in the thoracic cavity, congestion of the mesenteric and colic lymph glands and petechial and lenial hemorrhages on the heart. Of 22 pregnant mares used in transmission tests 9 were fed and injected with unfiltered material from aborted fetuses. Two of these aborted, and the fetuses showed tissue changes characteristic of the disease; the other

7 foaled normally. Ten mares were fed and injected with material which had been filtered thru a bacteria-proof filter; three of these aborted; 6 gave birth to normal foals and one proved not to be pregnant. Of three mares used in experiments on stall exposure, one aborted and two gave birth to normal foals. No bacteria were found in any of the foals aborted by the experimental mares.

Paratyphoid Bacilli. The possibility of differentiating strains of *S. aertrycke* from different outbreaks of animal diseases by the rapidity of their action on fermentable substances was investigated further. Twenty-one cultures of the variant of *S. aertrycke* from pigeons, which was called *S. aertrycke* var. *storrs*, were identified. These cultures were isolated from ten flocks of pigeons in six different states. The variant seems to be rather widely distributed geographically and to be quite closely associated with pigeons. Cultures of *S. aertrycke* from other species of domestic fowls did not belong to the variant type. The significance of this variant cannot be fully determined until a larger number of cultures from various animal species have been examined.

S. newport was isolated from a fatal case of hemorrhagic enteritis in feeder cattle. One other animal in the herd died but no specimens were submitted for examination. Several other cattle were ill but the herd was sold before specimens could be obtained. This is the first recorded case of *S. newport* infection in cattle and the first record of the occurrence of the bacillus in the United States.

Cultures isolated from quail in Illinois were identified as *S. oranienburg*. Cultures isolated from poults in New Jersey were identified as *S. senftenberg*. This is the first time either of these species has been recognized as the etiologic agent of animal disease and their first recorded occurrence in the United States.

Delayed Conception and Sterility in Dairy Heifers. The study of nephritis in connection with this investigation has been continued. Five of the non-breeders and unprofitable cows removed from the herd during the past year were found to have nephritis. The routine examination of the urine from these cows showed the presence of albumin since they were

heifers, that is for periods varying from four to six years. All the kidneys examined showed evidence of a chronic nephritis of long standing. The kidneys from three of the cows were infected with streptococci and *Escherichia coli*. In one of the cows, numerous soft, friable calculi, composed of magnesium phosphate, were found in the calyces of both kidneys. All the cases of nephritis studied in this herd since 1930 occurred in Jersey cows. During this period about one-third of the herd were Holsteins which were fed and housed exactly as were the Jerseys. In practically every case, albumin was found in the urine early in the life of the animal. Albumin was observed in one calf for a period of four months after birth, during which time it showed no evidence of any sickness which might cause this kidney complication. It may be that the tendency to nephritis is congenital in this herd.

Milk Fever. A study of the occurrence of milk fever in the Experiment Station herd showed that from 1916 to 1935, inclusive, 218 cows calved one or more times, producing 720 calves. These cows were distributed as follows according to breeds: Jerseys 148; Holsteins 49; Guernseys 17, and crossbreeds 4. All were housed and fed as one herd. There were 52 cases of milk fever among 33 of these cows in the period stated.

Milk fever occurred in a few cows which were not high producers, but the average life-time production of the cows that had milk fever was well above the herd average. No heifer had milk fever with her first parturition. One case of milk fever accompanied the birth of a second calf. All second calvings and all subsequent calvings must be considered as "susceptible calvings." Thirty-three percent of the "susceptible calvings" occurred during the months of January, February, March and April, while 57.7 percent of the milk fever cases occurred during the same period. The Jerseys in this herd seemed more susceptible than other breeds. Milk fever accompanied 12.4 percent of the "susceptible Jersey calvings," while only 3.9 percent of the "susceptible Holstein calvings" led to this condition. Slightly more cases of milk fever occurred during the drouth periods.

Aseptically Drawn Milk. Tests were made of 711 samples

of milk aseptically drawn from individual quarters of the udders of 184 cows in two commercial Kentucky dairy herds. The following determinations were made: bromthymol blue reaction, agglutination test for *Brucella abortus,* leucocyte count, and microscopic examination for the presence of streptococci. The results of the study are: (1) Bang's-disease-positive cows gave a higher percentage of positive reactions to each test than did Bang's-disease-negative cows. (2) The largest number of samples of milk positive to any two of the tests, except agglutination and bromthymol blue, and agglutination and examination for streptococci; the largest number positive to any three, and the largest number positive to any four of the tests, came from positive reactors for Bang's disease. Similarly, the largest number of samples negative to any two, three or four of the tests came from non-reactors. (3) It appears from these results that cows positive to Bang's disease are subject to considerably more udder trouble than cows negative to Bang's disease. (4) It also seems that proper care and management of herds containing both Bang's disease positive and negative cows may reduce the amount of udder trouble considerably.

Grass Tetany. During the spring of this year, the Station was called upon to investigate a disease of dairy cattle characterized by the sudden development of symptoms of tetany. This condition is usually seen in cows which have had access to young, rapidly growing grass. Most of the cows had recently calved. An examination of the blood from one of the cows gave the following results: blood sugar 41.0 mg. percent; inorganic phosphorus in whole blood, 2.3 mg. percent; serum calcium, 7.5 mg. percent; serum magnesium, 0.145 mg. percent. These chemical findings and the clinical history of this condition indicate that it is similar to a disease described in European literature as grass or lactation tetany.

Boron in Plant Growth. Plants were grown for three weeks in sand cultures receiving sufficient boron to maintain a mild toxicity, indicated by a slight necrosis of the lower leaves. Boron was then omitted from the nutrient solution. Boron deficiency, chlorosis and thickening of the developing leaves, and necrosis of the growing plant resulted in 10 days to 2

weeks. Analysis of the leaves during this period showed the boron content of the older leaves to remain fairly constant, while that of the new growth contained progressively less, traces only being detected as necrosis of the growing point occurred. This experiment indicates that boron is not translocated, to any extent, from the cells of the matured leaves.

Severe boron deficiency is characterized by the death of the growing point, the tissue in which cell division occurs. With the destruction of this tissue all growth ceases, but the matured leaves are not affected by the deficiency and continue their normal respiratory and photosynthetic functions. The fruiting parts of the plant are modified growing points; therefore fruits do not develop in boron-deficient plants. The result is that products of photosynthesis, chiefly starch, are deposited in leaf and stem tissues, often to the extent of rupturing the cells. This abnormal deposition of carbohydrates does not occur in plants from which the growing points are systematically removed.

Iodine Content of Plant Materials. In a further study of the occurrence, distribution and necessity of iodine for the growth of plants, 124 iodine determinations were made on plant materials from various sections of the state. Samples of corn grain, from Laurel, Clay, Bell, Whitley, Breathitt, Bracken, Mason, Owsley and Mercer counties ranged from 50 parts per billion in Mercer county to 520 in Bell county. Analyses of hay, wheat and other feeds show an average of about 300 parts per billion iodine. Since no information could be obtained as to the treatment of the soils on which the crops were grown, no deductions can be made as to the influence of the iodine content of the soil on the iodine content of crops produced. However, there is every indication that feedstuffs produced on most Kentucky soils contain sufficient iodine for the normal growth of animals.

Iodine in Soils, Fertilizers and Limestone. One hundred and twelve iodine determinations were made on soils, fertilizers and limestones. A Laurel county soil contained 0.93 parts per million of iodine and an Owen county soil, 4.48 parts. The iodine content of samples of soils taken at depths of 1 to 15 feet varied from 4.06 parts per million near the surface to a

trace at 13 to 15 foot depth. Phosphate rock varied from 1.4 parts per million (sample from Fayette county) to 15.6 parts per million (sample from Tennessee). A sample of Chilean nitrate of soda showed a total iodine content of 68.5 parts per million, only 26 percent of which was in the form of iodide.

Iodine in Milk. In cooperation with Berea College, the variation of the iodine content of milk was studied. Cows were fed various rations consisting of hay, grains, silage and specially mixed dairy feeds. Kelp was added to some of the rations. Feeds analyzed were lespedeza, special dairy rations, fitting feeds, certain advertised commercial feeds, silage and alfalfa. Their iodine content varied from 174 to 600 parts per million. The iodine content of milk from cows fed on these feeds ranged from 104 to 181 parts per billion. Feeds to which kelp was added showed an iodine content of 100 to 132 parts per million, which is about 400 times the average iodine content of some untreated feeds. Milk from cows fed the treated feeds showed an iodine content of 3,000 to 4,000 parts per billion, which is about 30 times the iodine content of milk from cows fed a normal ration. It thus appears that it is possible to materially increase the iodine content of milk by giving the cows an iodine compound in their feed.

Effect of Iodine on the Growth of Tomatoes. Tomato plants were grown in pots of a uniformly mixed soil, the iodine content of which was 5.0 parts per million. Potassium iodide was added to six lots of 3 each of these pots in such amounts that the iodine content was 10, 25, 50, 100, 250 and 500 parts per million of the dry soil. The pots were kept carefully watered to 20 percent of the soil weight. Within 3 weeks marked differences in the plants were apparent. The plants grown in 10 parts per million iodine were slightly larger than the others; those grown in 50 parts per million were slightly smaller than those of lower iodine concentration. Plants grown in 100 parts per million were much smaller and the leaf tips were brown. Those in 250 parts per million made very little growth and those in 500 parts per million were dead. This same difference in size continued thruout the growth of the plants. The 10 and 25 parts per million treatments gave a slight increase in dry weight when compared with the control plants;

applications greater than 25 parts per million resulted in smaller yields than from the controls. The variation in dry weight of the controls was small. Apparently the maximum amount of iodine tolerated by tomato plants grown in this particular soil is 50 parts per million. Iodine toxicity manifested itself by retarded growth and browning of the leaf tips.

Effect of Iodine on Growth of Buckwheat in Water Cultures. Buckwheat plants were started in purified sand and transferred to glazed earthenware pots filled with nutrient solution containing iodine in the form of potassium iodide in amounts varying from 0 to 10 parts per million. Plants in solutions containing 10 parts per million of iodine died immediately. Those in solutions containing 0.5 and 4.0 parts per million iodine showed slight increase in dry weight over the control plants. Concentrations greater than 4 parts per million produced toxic effects. These grew as well as the check pots or possibly better, and the dry weight of the mature plants was slightly larger. Symptoms of toxicity appeared first at the leaf tip; ultimately the entire leaf would become brown and drop from the plant. Plants grown in cultures from which manganese, zinc, copper and boron are omitted fail to produce seed. The omission of iodine from the culture did not affect seed production; however, sufficient iodine may have been present in the seed from which the plants were grown to promote reproduction.

Effect of Iodine on Growth of Tobacco. Tobacco was grown in pots of soil containing 5 to 100 parts per million of iodine. No stimulation of growth could be detected. Marked toxicity was manifest in soil containing more than 50 parts per million iodine. Young plants were very susceptible to applications of too much iodine, whereas the older plants seemed to develop a tolerance for iodine if it was added gradually.

Oil-Nicotine Spray. Tests of free nicotine in soil showed that atomized oil-nicotine spray could be safely applied to plants with a high percentage of destruction of insects. The oil used was a completely volatile, highly-refined petroleum distillate, that was colorless, odorless and tasteless.

Oil-nicotine spray can be prepared in two ways: by adding 100 percent free nicotine to the correct oil base; or by shaking

the 50 percent solution of free nicotine with the oil and then separating the oil-nicotine from the settled water and brown impurities. One percent free nicotine in oil proved to be a suitable strength for field and greenhouse use. It gave little discomfort to the operator and had a toxicity equivalent to 0.1% pyrethrum in oil. This spray must be applied in the form of a fine mist or fog to avoid foliage injury. Several spray nozzles and a continuous hand atomizer have been devised.

Nicotine and Moisture Content of Tobacco. Approximately 450 samples of tobacco were analyzed for their moisture and nicotine content, in connection with the work in breeding Burley tobacco for a low nicotine content. Apparently some of the low-nicotine crosses contained as much nicotine as the parent plants or even more.

Effect of Soil Nitrogen Content on Yield and Quality of Burley Tobacco. Different levels of soluble nitrogen were maintained in different plots during the growth of the crop, by adding fertilizer nitrogen as needed. Urea was used in 1935. Results from certain of these plots in that year are as follows:

Plot No.	Average amount of nitrate-nitrogen per acre found at 5 times when sampled	Nitrogen (in urea) added per acre	Tobacco	
			Yield per acre	Estimated value
	lbs.	lbs.	lbs.	$
104, 107	23	None	920	187
105	33	40	1150	229
106	67	120	1730	430

The dry weight and nitrogen in the tobacco from these plots, except 104, are as follows:

		Plot 107	Plot 105	Plot 106
Urea applied	lbs. per A.	None	40	120
Yield of leaf	"	916	1150	1730
Yield of stalks	"	616	889	1295
Total		1532	2039	3025
Nitrogen in the leaf	percent	2.26	2.58	3.86
" " " stalks	"	2.29	2.55	3.28
" " " leaf	lbs. per A.	20.7	29.7	66.8
" " " stalks	"	14.1	22.7	42.5
Total	"	34.8	52.4	109.3

Comparison of Nitrogen Fertilizers for Tobacco. The effect of

different nitrogen carriers on the yield and quality of Burley tobacco in 1935 is shown below:

Plot No.	Nitrogen at the rate of 48 lbs. per acre applied in the form of	Yield lbs. per acre	Estimated value--dollars per acre
111	Sodium nitrate along the row at setting	1201	262
117	Sodium nitrate along the row, half at setting and half when plants were 12″ high	1197	317
114	Ammonium sulfate at setting	1129	264
112	Urea at setting	1077	229
115	Calcium cyanamid at setting	1029	243
110, 113 116, 119	None	916	190

The tobacco in these studies was grown in a four-year rotation of corn (rye cover crop), tobacco, rye and orchard grass and Korean lespedeza two years. The corn, rye, and hay crops were removed. The rotation was designed so that the soil would supply a relatively small amount of nitrogen to the crop and thus facilitate the nitrogen studies. The amount of nitrate nitrogen in plots in this and two other rotations, in 1936, in early summer, before the tobacco had affected the amount and again, in the fall, before the fall grain had affected the amount, was:

	Nitrate nitrogen, lbs. per acre	
	June 9	Oct. 19
The 4-year rotation just described	31	45
Tobacco, rye, orchard grass and red clover, two years. Rye and sod crops clipped and left on	87	106
Same as preceding except bluegrass instead of orchard grass	133	93

The large amount of nitrate in the plots in the fall, particularly the last two, due in part to the extremely dry season, emphasizes the importance of fall-seeded crops to prevent leaching.

Tobacco-Curing Experiments. Experiments in curing tobacco were begun which may be carried for a number of years. The objectives are (1) to determine the effects of various temperatures, humidities and length of exposure during the yellowing period, upon the quality of the cured leaf of Burley, dark-fired and dark air-cured tobacco; (2) to determine the effects of various air conditions during the drying period,

upon the quality of the cured leaf of White Burley and dark air-cured tobacco; (3) to determine the role of temperature, humidity and smoke in producing the desired qualities of fired tobacco.

Heating, Ventilation and Control of Humidity and Temperature in Tobacco Barns. Studies were started in 1936 in tobacco curing barns at the Experiment Station and at the Western Kentucky Substation, to get information on which to base possible changes in the design and management of barns and ventilating and heating equipment, to give the best of curing conditions. The objectives are: to study practices in barns of standard construction, get records of variations in temperature and humidity in various parts of the barn and how they are affected by outside weather conditions; to see how air currents in the barn are influenced by the sun, wind, management of ventilator openings, coke burning, and outside air currents; to gather data as to the rate and amount of moisture given off by tobacco plants as a factor in controlling temperature and humidity, and finally, to observe problems in burning coke in salamanders placed on the floor of the barn.

Rate of Liming Tobacco. Injurious effects on tobacco of the very heavy applications of limestone made in this experiment are still apparent as shown by relative values in 1935, which were $103.80 per acre where the rate of liming was 20 tons or more per acre, and $143.00 per acre where no limestone was used. The lower values were due entirely to poor quality, as the heavily limed plots yielded the heaviest of all.

With red clover and, to a limited extent, with corn in certain years, heavy applications of limestone, above 10 tons an acre, reduced yield. With clover the reduction amounted to nearly 30 percent as compared with check plots treated with limestone.

New Tobacco Diseases. Two stalk diseases of tobacco were recognized in this State for the first time in 1936. One was a stalk rot of dark tobacco caused by a species of Rhizoctonia closely resembling *R. solani.* The other was a phloem necrosis of the stalk of nearly mature Burley tobacco. Decay extended from the ground line to 2½ feet or more up the stalk. The stalk to this height was blackened, but discoloration extended up the vascular tissue somewhat farther. The xylem

and pith were unaffected. Rot spread into the petioles and destroyed a small portion of the frill at the base of the leaf. All the leaves turned yellow but only the lower leaves wilted. Bacteria were abundant in freshly decaying tissue. The organism is capable of causing pith decay of tobacco, and may be identical with *Bacillus aroideae,* the cause of hollow stalk and black leg. Four stalk rots all resembling one another superficially have been found so far in the State. The other two are caused by *Phytophthora parasitica* var. *nicotianae* and *Sclerotium bataticola.*

Black shank, *Phytophthora parasitica* var. *nicotianae* was reported in two tobacco fields in Todd county in 1935. Evidence was obtained that it was also present in a field in Logan county in 1935. A field in Tennessee close to the field in Logan county, Kentucky, was badly damaged by black shank in 1936. The disease appeared a few days after a heavy rain in areas of the field receiving overflow from the Logan county field in 1935. The grower stated that the same disease was present in the Logan county field in 1935.

Blue mold or downy mildew of tobacco, *Peronospora tabacina,* was found in Kentucky for the first time in Todd county June 10, 1936, and subsequently, in 5 bed areas. Tobacco was only about half set at the time, but the season was late. Only shaded portions of the beds were affected.

Tobacco Mosaic. Hybrids between the mosaic-resistant Ambalema tobacco and the highly susceptible White Burley were made. The second generation of this cross yielded a few White Burley plants that appear to be as resistant to various strains of the mosaic virus as the Ambalema parent. There is sufficient variation in type of the resistant hybrids to suggest that there will be little difficulty in developing desirable types of mosaic-resistant Burley and dark tobaccos.

In studying the inheritance of mosaic resistance and the sensitivity factor of Ambalema and its hybrids, some confusion arose because Ambalema is not completely resistant to many strains of the virus and consequently it is not always possible to determine correctly whether a plant was resistant or partially susceptible. In a study of about 600 F^2 plants of Burley 16, susceptible and non-sensitive x Ambalema, resistant and sensitive, growing in the field, the plants were inocu-

lated with the white mosaic virus, a necrotic spotting strain. With this virus the classes were well enough defined so that 15 phenotypes could be distinguished in numbers closely approaching the theoretical. Resistant plants appeared in the ratio of 1:12.6, theoretical 1:15, suggesting two pairs of factors for resistance. White Burley plants appeared in the ratio of 1:14.9. Of 40 Burleys, 2 were resistant, of an expected 2.5.

Overwintering of Mosaic in Diseased Roots, Stalks and Leaves. For the fourth consecutive year, there was little evidence that the mosaic virus contained in the dead roots of plants inoculated the previous summer with 2 recognizable strains, was an important source of mosaic infection. In 800 plants growing in soil in which infected plants had grown the previous summer, only one developed mosaic corresponding to one of the strains used the previous year. When the stalks and leaves from the diseased plants of the previous year were cured, ground up and added to land shortly before setting, the results were as follows:

Rows	Treatment	Percent yellow mosaic	Percent mosaic burn
1– 4	Mosaic burn, stalks	0	37.1
5– 7	No addition	0	0
8-11	Mosaic burn, leaves	0	8.5
12–14	No addition	0	1.2
15–18	Yellow mosaic, stalks	12.5	0
19–21	No addition	2.0	0
22-25	Yellow mosaic, leaves	13.0	0
26–28	No addition	.8	0

The importance of home-cured tobacco as a source of tobacco mosaic infection was again illustrated in a survey of 113 fields of dark tobacco in western Kentucky in 1936. In 84 fields, where the growers used home-cured tobacco for chewing or smoking, while handling plants, the average infection just before cutting was 39.9 percent, with a range of 6.7 to 90 percent. In 29 fields where the growers did not use home-cured tobacco while handing plants, the average percentage of mosaic prior to cutting was 1.8, with a range from 0 to 6.6 percent.

Thermal Inactivation of Tobacco Mosaic Virus. Thermal inactivation time of three strains of tobacco mosaic virus, yellow mosaic, green mosaic and burning mosaic, in cured

tobacco leaves, was determined for dry heat. The data indicated that infectious material exposed at 80, 90, 100 and 110 degrees Centigrade for 50, 20, 10 and 5 hours, respectively, was non-infectious according to the bean-local-lesion method of measuring virus activity. There was no appreciable difference in the action of dry heat on the three strains of virus. Samples exposed at 70 degrees Centigrade for 60 hours remained infectious but their infectiousness was greatly reduced. According to these results, cured tobacco leaves to be used by growers for chewing and smoking may be heated to 110 degrees Centigrade or 230 degrees Fahrenheit for five hours to completely inactivate the infectious agent that may be present in the tobacco. The use of non-infectious tobacco by growers should reduce the incidence of the disease since workmen's use of infectious tobacco appears to be the principal source of spreading the disease in Kentucky.

Trisodium Phosphate to Inactivate Tobacco Mosaic Virus. Tobacco mosaic in Kentucky can usually be traced to the grower who has handled dry mosaic tobacco previous to handling the plants in the plant bed. A chemical which is harmless to the hands but which inactivates the virus, and is inexpensive, is an aid in mosaic control. Trisodium phosphate has been shown by tests at the Kentucky Experiment Station to inactivate the virus quickly when a concentrated solution is used. In testing the value of the solution the experimenter's hands were thoroly contaminated with mosaic virus, and then dipped 4 times in a concentrated solution of the chemical in water and lightly rinsed in water. One hundred plants were inoculated by rubbing a small portion of a leaf between the thumb and finger after the hands were dry, and another lot of 200 plants were inoculated in the same way except that the hands were kept moist with water while inoculating. Thirty-two days later no mosaic had developed, in the 300 plants, while about 90 percent of the plants inoculated before dipping the hands in the solution had developed the disease. The chemical has the qualities of inexpensiveness and availability, and may prove valuable if the hands are dipped into it occasionally while plants are being pulled or weeded.

Root-rot Resistant Varieties of Tobacco. A root-rot resistant

variety of White Burley designated Kentucky No. 16 was introduced in 1935. It has replaced Kentucky No. 5 in the plots on the Experiment Station farm for two years, and tests by farmers have indicated that it is satisfactory. It is larger than No. 5, matures a few days later, and yields more heavily and consistently on soils not most suitable for Burley tobacco. Several root-rot resistant strains of dark-fired tobacco developed by hybridization were tested during the past summer by farmers in western Kentucky. Growth and type of plant were satisfactory. In at least one instance a root-rot resistant variety produced high-quality snuff tobacco.

Fusarium Wilt of White Burley Tobacco. This disease is now found quite commonly in the sandy soils along the Ohio River and in similar soils in other parts of the state. Where tobacco is grown frequently on infested soil most of the crop may be destroyed. Breeding for resistance to this disease was conducted along two lines: (1) hybridization of White Burley with a highly resistant variety of Turkish tobacco and, (2) hybridization between varieties of White Burley, each of which was susceptible to wilt. The former method produced highly resistant strains but none are of a desirable type, the latter produced two varieties which are moderately resistant and of good quality. These varieties are being distributed to farmers who are troubled by the disease.

Overwintering of Bacterial Leafspots of Tobacco. To discover ways other than in cured tobacco, by which the casual organisms of angular leafspot and wildfire over-winter, tobacco plants were inoculated with bacteria obtained from a wide range of cultivated and wild plants collected in the vicinity of Lexington and in western Kentucky. In some instances inoculations caused spotting on tobacco leaves in which the bacteria appeared to multiply but typical angular leafspot or wildfire was never consistently produced except from physalis, as previously reported.

Nature of the Toxin Produced by B. tabacum. The toxin produced in broth cultures of the organism was found to be insoluble in diethyl ether, chloroform, xylene, benzene, carbon tetrachloride, and ethyl alcohol, but soluble in glacial acetic acid. Previous work on the toxin was confirmed in that it was resistant to boiling, acid permanganate, mercury bichlor-

ide, phenol, and silver nitrate and susceptible to alkali or alkaline permanganate.

Preparation of half calcium salt of d-tartaric methyl ester is under way for the purpose of using the material to detect pectase activity of bacteria and fungi pathogenic to tobacco. In the presence of pectase the substance hydrolyzes to methyl alcohol and insoluble calcium tartrate is precipitated.

Preliminary inoculations to tobacco with different isolants of *B. angulatum* and *B. tabacum* indicate that there are strains to each that vary in pathogenicity. When two isolants of *B. angulatum* were used to inoculate the same leaf of tobacco, one on each side of the midrib, there was often a marked contrast in size of the spots.. Isolants of *B. tabacum* behaved similarly.

Inoculation tests with *B. angulatum* and *B. tabacum* indicate that they can readily be carried thru plant after plant of 4 varieties of cowpea, and thru soybean, Ruby King and Red Chili pepper, June Pink and Marglobe tomato, *Datura stramonium* and *Nicotiana glutinosa.* In *N. rustica, N. sanderae, N. langsdorffii, Physalis subglabrata* and *Solanum carolinense,* it was difficult to get infection and multiplication of the organisms was either not marked or uncertain.

Bordeaux mixture, 3-4-50, was applied, one quart to the square yard, in tobacco plant beds in Todd and Logan counties to determine if infection from *B. angulatum* and *B. tabacum* could be prevented and if crops set from these beds remained more free from infection than those set from untreated beds. Fifty-three beds of dark fire-cured tobacco, of 7,500 square yards; 6 beds of air-cured dark tobacco, of 600 square yards, and 9 beds of Burley, of 700 square yards, were treated when the plants were about the size of a dime, and again two weeks later. Wildfire developed in a few plants in each of 5, and angular leafspot in a few plants in 2 beds out of the 68 treated beds. Wildfire was seen in 19 and angular leafspot in 5 untreated beds, where many more plants were affected than in treated beds. Wildfire caused considerable damage in 10 fields, and angular leafspot in 3 fields, in Todd and Logan counties. All these fields were set from untreated beds. In no case did either wildfire or angular leafspot cause damage to the crops in fields set from Bordeaux-treated beds, but it

must be pointed out that many fields were seen where neither wildfire nor angular leafspot were present in crops set from untreated beds. As there was a season-long drouth and relative freedom from these bacterial diseases in 1936, no conclusions can be drawn from the tests.

Control of Wireworm Injury to Tobacco Plants. The 1936 season was not favorable for transplanting tobacco because of lack of moisture in the soil. Transplanted plants often remained wilted for several days, making it almost impossible to detect those affected by wireworm injury, but wireworms were evidently present as pulled plants showed injury. A predominant species of wireworm, *Aeolus dorsatus* Say, was the only one found to be injuring plants; others were found in the soil around injured plants but were not doing the actual damage.

Tests showed that a plot plowed in the spring had only 14.5 percent of plants injured by wireworms, while an adjoining plot plowed in the fall of 1935 had 19.7 percent. Plants set May 22 had 31 percent injured; June 1,27 percent; June 8, 26 percent; June 13, 28 percent; June 19, 6 percent. In a further test, plants set in ridges about 6 inches high had 15.6 percent injured, and those set in furrows about 6 inches deep had 24.2 percent.

Plowing, harrowing and disking have been recommended as control measures. In the spring of 1936, two plots were given five diskings in addition to the usual preparation of the land for planting. The soil in one plot was stirred to a 4-inch depth, and in the other to 2 inches. The percentages of injured plants on these plots were 23 and 26, respectively.

No noteworthy difference in resistance to wireworms was observed among the strains of white burley tobacco, Ky. 5, Ky. 7, Ky. 16 and Kelley; nor was there any appreciable difference in wireworm resistance in young plants of different size ranging from 3/16 to 3/8 of an inch in diameter.

Tobacco grown the second year in a plot showed considerably less injury than the first year. The estimate in 1935 was 38.8 percent and in 1936, 11.8 percent, a reduction of about 20 per cent.

Effect of Burning Tobacco Beds to Control White Grubs. White grubs were confined in folds of cheesecloth and placed at

different levels, from two to ten inches, in the soil of a tobacco bed which was then burned. All grubs at two inches were killed, 84 to 100 percent at three inches, 38 to 60 percent at four inches, and 8 to 24 percent at five inches. As a good many grubs had been found to be below the five-inch depth when the bed was plowed, it appears that burning may allow many grubs to escape.

The Tobacco Flea Beetle. Tho beetles were not numerous in the spring of 1936, control measures were tried. Dust insecticides were applied May 7 and May 15, and portions of the bed were protected by boxing and covering tightly with tobacco cotton. Five replications were made of each control measure. The average percentages of injured plants were as follows: (1) derris root powder mixed with infusorial earth to give 1 percent rotenone, 28 percent; (2) a similar dust containing 2 percent rotenone, 28 percent; (3) synthetic cryolite 4 parts and infusorial earth 6 parts, 19.08 percent; (4) barium fluosilicate 8 parts and 20 parts inert matter, 15 percent; (5) with no treatment, 32 percent; (6) boxed and tightly covered, 2 percent. If it is desirable to use an insecticide to control flea beetle in a bed, barium fluosilicate is recommended on the basis of this test.

Variety Tests of Corn and Corn Breeding. Because of drouth during most of the growing season, only light, chaffy corn was produced, and yields varied from practically nothing to 40 bushels an acre. As the largest rainfall was in August when the medium-early varieties were silking, these pollinated and had the largest yields. The superiority of hybrids, particularly of the Kentucky hybrids under severe drouth was a striking feature. Yields of hybrids were better than those of open-pollinated varieties. The Kentucky Experiment Station strain of Boone County White was used as a check. The average yield of 6 plots of this variety was 26 bushels an acre, and that of 12 Kentucky hybrids was 34.2 bushels, an increase of 31.5 percent. The yield of hybrid No. 72, 40 bushels an acre, was the largest. Rather large quantities of seed of several hybrids were sent out for trial this year and some growers had exceptional yields, but few reported actual figures. In tests in Cumberland county, and at the Princeton, Mayfield, Greenville and Campbellsville soil fields, the hybrids

yielded 5 to 23.5 bushels more corn per acre than the controls.

At least 300 bushels of hybrids 69 and 72 were produced in the state in 1936 by growers who were furnished the single-cross seed by the Experiment Station.

The attempt to find the best combinations of the inbred strains so far produced, and to produce others to meet specific needs, caused breeding work with corn to be greatly increased. Every effort is being made to produce inbred strains of yellow corn as satisfactory as the white hybrids already tested. Despite the drouth, at least a few ears of most of the inbred strains were produced. Irrigation was necessary to obtain sufficient single-cross seed to supply the needs of commercial growers for 1937. Several inbred strains were found to be outstandingly superior in ability to withstand drouth.

Two new yellow varieties, Midland Yellow and Yellow Pride of Saline, were sent out for trial. The latter variety was developed by crossing a rather early yellow corn with the White Pride of Saline and backcrossing the yellow progeny several times with Pride of Saline. Much like Pride of Saline in many respects, this yellow variety is slightly earlier. At the Quicksand Substation it was found to be superior to Reid's, and other reports also indicate that it may prove well adapted for Kentucky.

Relation of Soil Productivity and Diseases to Clover Failure. Dominant factors which limited the yield of red clover were severe drouth and hot weather of the summer. Varieties and lots that satisfactorily survived the summer of 1935, the year of seeding, winter-killed little or not at all, despite the cold weather in the winter of 1935-36. Four Kentucky adapted varieties yielded from, one cutting, 2300 to 2800 pounds of barn hay; four from Ohio, Tennessee and Maryland, 2000 to 2150 pounds, and three from Oregon, North Carolina and Virginia, 1500 to 1800 pounds. Only one cutting was made, because of drouth. French, English and Italian lots failed.

A fungus disease, caused by *Sclerotium bataticola,* developed about July 1 in scattered areas in the part of the experiment field sloping south and west, and by the end of summer all clovers in the affected part were destroyed. Apparently no variety was more resistant than another, which indicates that

the disease has not been a common factor in the natural development of adapted native varieties. The disease was much less severe in that part of the field which slopes to the east.

The clovers seeded in the spring of 1936 produced excellent stands, but the drouth and hot weather so reduced them that it is doubtful whether the remaining stands bear any relation to degree of adaptation, altho on the whole, native varieties had the better stands. So far as could be ascertained, no disease contributed to the destruction of the stands. Studies made at the Berea field did not indicate that root diseases are less serious for our adapted Kentucky varieties than for unadapted kinds; however, for the past few years these diseases were not so serious as formerly, perhaps because the drouth in 1930 practically sterilized the soil.

Red Clover Breeding. This work made satisfactory progress during the year, despite the drouth. The strain being developed for short rotations made a good crop of hay when grown in a 3-year rotation of corn, wheat and clover, a rotation that rarely produces satisfactory yields of clover on the Experiment Station farm. Seed was saved from the second crop. This strain must be tested for several years before its value can be established. Seed was obtained from the second cutting of the perennial strain being developed at Berea. In progress for approximately 10 years, there is evidence that the work will be successful eventually, tho the perennial character is still far from being established. Drouths of recent years have handicapped the work.

Work begun last year in cooperation with the United States Department of Agriculture, Bureau of Plant Industry, to develop one superior variety of red clover for general use in the southern part of the clover area, using the best old varieties from the several states as foundation material, has progressed satisfactorily.

Chemical Analyses of Legumes, Grasses and Corn. Samples of red clover, alfalfa, lespedeza sericea, Kentucky bluegrass, orchard grass, redtop and timothy grown on the Experiment Station farm at Lexington were analyzed. The following percentages are calculated on the water-free material. The grasses, cut when about 4 inches high (pasture stage), contained 17.25 to 18.80 percent of protein. Lespedeza sericea,

cut when 5 inches high (pasture stage) contained 13.1 percent protein, 23.9 percent fiber, 6.7 percent ash and 0.26 percent phosphorus. Alfalfa, at the same height, contained 33.0, 16.4, 11.3 and 0.55 percent of these constituents, respectively. Red clover, at the same height, contained 34.4, 13.4, 10.5 and 0.52 percent, respectively.

Thirty-one samples of high-grade shelled corn were analyzed. Fourteen of these were from cribs on farms, and seventeen from commercial lots. Wide differences were found in amounts of certain important constituents, as indicated by the following ranges; protein, 8.3 to 11.9 percent; calcium, 0.022 to 0.12 percent; phosphorus, 0.24 to 0.35 percent; potassium, 0.29 to 0.44 percent. Other important constituents were rather uniform. The least variation was in nitrogen-free extract from 79.6 to 83.4 percent. It is evident that the differences in composition of different lots of high-grade corn may be sufficient to produce different amounts of gain in livestock per unit of corn fed.

Continuous vs. Alternate Grazing of Permanent Pastures. Total gain in weight made by heifers in 189 days on the continuously grazed area, with no supplementary feeding, was 195 pounds per acre, while that made on the alternately grazed areas was 203 pounds per acre. These gains may be regarded as identical. It is noteworthy that they were made when rainfall at Lexington, May to October, inclusive, was only 59 percent of normal and the temperature averaged 5.9 percent above normal. In addition to doubling the usual normal gain, the heifers exceeded the normal increase in height by approximately 35 percent, despite the fact that after the first few weeks the pastures were closely grazed.

Improvement of Bluegrass for Pasture and Seed Production. Application of 300 pounds of nitrate of soda per acre to bluegrass sod in the latter half of the calendar year again produced better sod and larger growth than application in the first half. The residual beneficial effect of legumes on bluegrass was very pronounced last summer. Because of drouth and hot weather, legumes were almost entirely absent after early spring. Average yields of air-dry herbage, which was almost wholly grass, were 283 pounds per acre from plots free

of legumes, and 1,942 pounds from those in which legumes are occasionally seeded.

While there is no indication that Kentucky bluegrass seed harvested in Kentucky produced bluegrass better adapted to this state than seed from other bluegrass seed-producing regions in the United States, it is again evident that there are considerable differences in the appearance and habits of bluegrass sods established from seed from old fields. These differences mean that changes in type are taking place in old fields, as bluegrass is almost wholly self-fertilized under field conditions. Segregation of plant types within a region raises questions that should be studied in relation to management practices.

Three of 40 pure lines being tested in the bluegrass improvement project were outstanding in ability to make some growth and remain green longer during severe drouth and hot weather. Following rains, four recovered from drouth effects definitely sooner than others. Six strains stood the drouth and heat without loss of stand, whereas others were injured to some extent, and some were seriously affected. No one strain combined all three good qualities.

Timothy. Tests of several new strains of timothy, made in cooperation with the U. S. Bureau of Plant Industry, support the tentative conclusion of previous years that early strains are much superior to mid-season or late strains. It is desired that field tests may soon be made to find the strains best adapted for Kentucky.

Lespedeza. Variety tests at Lexington and other soil fields failed because of drouth, except at Fariston where an established stand, benefited by rains after midsummer, produced two cuttings of 4,850 pounds of hay per acre from Strain 04730, and 5,775 pounds from Strain 12087.

White Clover. Strains native to central Kentucky withstood a combination of environmental factors that destroyed or severely injured those from distant regions. A commercial strain produced in Louisiana and Mississippi appeared superior, under Kentucky conditions, to most others, but was distinctly inferior to native Kentucky kinds. However, even the Kentucky strains did not survive the drouth and hot weather of the summer of 1936.

Soil Fields. The drouth emphasized the desirability of growing alfalfa for hay. First-year alfalfa in a 4-year rotation of corn, wheat and alfalfa yielded 1.2 tons an acre in two cuttings; second-year alfalfa yielded 2.5 tons in three cuttings, and third-year alfalfa in a rotation of barley and three years of alfalfa yielded 3.3 tons per acre.

A selected strain of clover for short rotation yielded 2,700 pounds an acre on land that had been in a rotation of corn, wheat and clover since 1920. The strain is being further developed and seed is not yet available for distribution.

Results on the experiment fields show the value of certain soil-management practices under the very severe drouth conditions. Yields for the outlying fields are given in the following table:

Crop yields from general fertility tests, outlying soil experiment fields, 1936

Field	Corn, Bus.			Wheat, Bus.			Hay, Lbs.		
	O	M	MLP	O	M	MLP	O	M	MLP
Berea	2.1	9.0	36.0	Wheat not grown			335	760	2310
Fariston	3.1	7.6	46.4	0.0	0.0	17.7		failure	
Campbellsville	7.4	40.9	59.4	0.8	2.8	12.5	185	1575	1965
Greenville	4.9	17.0	30.0	0.5	5.5	25.7	255	435	1200
Mayfield	20.3	43.1	45.3	1.3	5.1	18.9	3580	3940	4980

O: no fertilizer; M: manure; MLP: manure, limestone and superphosphate.

Manure is applied equal to the weight of the crops removed, except wheat grain. Except at Berea, limestone has not been used in any of these tests since 1923 and the total application prior to 1923 ranged from 4 to 6 tons an acre. At Berea 1 ton an acre additional has been used. Superphosphate applications were originally an average of 200 pounds an acre yearly, but for several years 100 pounds of 16 percent superphosphate have been used. The rotation at Campbellsville is corn, wheat, and mixed grass and legumes for the third-year crop; at the other fields, it is a 4-year rotation with the hay crop covering 2 years. At Berea, rye is used instead of wheat and is clipped down to represent pasturing.

Tobacco yields in 1935 on three of the soil fields are given in the following table. A 6-year rotation is used; tobacco 2 years, wheat, legumes and bluegrass 3 years. At Campbellsville and Mayfield 5 tons of manure an acre is used. No limestone has been used since 1923 but 6 tons were used at Green-

ville and Mayfield and 4 tons at Campbellsville before that. This was too much and injured the tobacco, but the bad effect has almost disappeared. The complete fertilizer (PKN) application was 250 pounds of 20 percent superphosphate, 100 pounds of sulfate of potash and 200 pounds of nitrate of soda, approximately equivalent to 600 pounds of a 5-8-8 analysis. Superphosphate was used at the rate of 250 pounds in the LP treatment.

Yields and value of tobacco* for selected treatments on outlying soil experiment fields, 1936.

	Pounds per acre				Value per acre—dollars			
	O	LP	LPKN	PKN	O	LP	LPKN	PKN
Campbellsville	924	1150	1292	1664	101	133	213	308
Greenville	451	956	1248	1312	35	77	117	110
Mayfield	1094	1085	1232	1403	132	118	126	161

*White Burley tobacco at Campbellsville. Dark fire-cured tobacco at Greenville and Mayfield.

Effect of Limestone on Availability of Rock Phosphate. At Fariston, rock phosphate produced a larger return of corn and wheat than limestone and rock phosphate, in the beginning of the experiment. Rock phosphate was used at the rate of 1,600 pounds an acre for a 4-year rotation from 1916 to 1927, and at one-half this rate in the period, 1927-1936. Six tons of limestone an acre were applied between 1916 and 1923. The average yields for four years immediately following the last application of limestone, and for the last four crops, are given below. As wheat was dropped out of the rotation for a time beginning in 1923, the last four crops before this are shown. These and results on other fields show that land on which rock phosphate is used should not be heavily limed. (See also 1935 annual report). The following are the average yields per acre:

	First Period		Second Period	
	RP	LRP	RP	LRP
	bu.	bu.	lbs.	lbs.
Corn	36.0	29.7	44.0	49.9
Wheat	7.9	6.4	9.0	10.9
First-year hay	1198.0	2035.0	1650.0	4257.0

Comparison of Phosphates under Field and Greenhouse Conditions. In cooperation with the Tennessee Valley Authority,

comparisons were continued with ordinary superphosphate, triple superphosphate, dicalcium phosphate and tricalcium phosphate. Comparisons are made in a rotation of (1) corn (2) wheat and (3) a mixture of clover and Korean lespedeza. The tests were started in 1934 except at Fariston and Smithland, where they were started in 1935. Supplemental tests at Campbellsville and Murray were started in 1936.

When the work was started, limestone was applied at the rate of 2 tons an acre. For corn, a 4-10-6 fertilizer made with the different kinds of phosphate is applied to the hill. When wheat is seeded, fertilizer is applied for both wheat and the following hay crop. The rate is 40 pounds an acre of phosphoric acid derived from the different phosphates. One hundred and fifty pounds of muriate of potash an acre is applied to wheat at the time it is top-dressed, in the spring, with 150 pounds of nitrate of soda an acre. Check plots are given the same potash and nitrogen treatment as the phosphate plots.

On unlimed land the phosphates were about equally effective for corn except that tricalcium phosphate was a little less effective. For wheat they were about equally effective except that the dicalcium was a little more effective. On hay the tricalcium phosphate was somewhat more effective than the others.

On limed land, for corn, the ordinary superphosphate and the triple superphosphate were the most effective, being about equal. The tricalcium form was decidedly less effective. For wheat, they were equally effective except that tricalcium was decidedly less effective. For hay, the dicalcium was most effective and the tricalcium the least effective.

The average of the results of two years' tests of the availability of phosphates, as determined in the greenhouse, shows that (1) ordinary superphosphate, monocalcium phosphate and dicalcium phosphate were about equally available to Turkish tobacco; (2) tricalcium phosphate was less available, and rock phosphate only slightly available, to Turkish tobacco; (3) tricalcium phosphate and rock phosphate, which were only slightly available to Turkish tobacco were more available to red clover, as were the other phosphates.

The total recovery of phosphorus in the clover during the

two years, from the phosphates added to supply 55 pounds P_2O_5 per 2,000,000 pounds of soil, was as follows:

Phosphate	Percentage recovery	
	Campbellsville soil	Mayfield soil
Super	49.1	85.4
Monocalcium	62.0	51.6
Dicalcium	54.2	43.3
Tricalcium	33.3	33.1
Rock	4.6	24.5

Residual phosphate from last year was definitely more available to red clover than to Turkish tobacco. There was large recovery in the two clover crops of the three more available phosphates. Averaging all tests, it is found that the percentage of added phosphorus recovered in the crops was 57.6.

Effect of Manure in a Cropping Rotation. A test at Mayfield shows the value of conserving and using manure. Two adjoining sets of plots, four in each set, were treated equally with limestone and superphosphate. Cropping was begun in 1913. From 1916 to 1919 manure was used each year for corn on one set of plots, at the rate of 6 tons an acre. Beginning with 1921, it has been returned in amount equal to the weight of the crop harvested. On the other set, the cornstalks and wheat straw were returned from 1916 to 1920. Since then no manure or residues have been returned to this set. The rotation was corn, soybeans, wheat and mixed clover and grass through 1931, when soybeans were dropped; since then legumes and grass have occupied the last two years of the rotation. The average yields of crops under the two systems are given below for 1913-20 and 1921-36.

	Plots With Manure	Plots Without Manure
Corn thru 1920	32.3 Bus.	33.0 Bus.
Corn 1921–36	50.5	33.3
Wheat thru 1920	16.7	15.6
Wheat 1921–36	21.9	18.2
First-year hay thru 1920	3173.0 lbs.	2903.0 lbs.
First–year hay 1921–35	4113.0	3351.0

There were some crop failures but these do not affect the comparisons, for the failures occurred under both systems. The yields of corn in 1936 were 42.9 bushels and 19.3 bushels,

respectively. The corn showed decided symptoms of potash deficiency where manure was not used.

Cover Crops in a Young Apple Orchard. A cover crop test in a young apple orchard has been in progress for 7 years. The trend of results approximates that of 1935. The plot which was cultivated and had cover crops of the non-legumes, millet and barley, continued to produce greater tree growth than those on other plots which were not cultivated but had good growths of legume crops, lespedeza, sweet clover and soybeans. Analyses of woody tissue showed that trees on the cultivated, non-legume plot had a higher content of soluble nitrogen than those on the other plots. Sufficient time has elapsed since this test started for the legume crops to build up a nitrogen supply in the soil, and for the non-legume crops to have reduced the nitrogen supply, but the trend remains the same.

A New Method for Determining Soil Moisture. In the course of certain investigations, it was found necessary to determine the percentage of moisture in the soil used more speedily than could be done by drying to constant weight. The new method is based on the fact that concentrated sulfuric acid produces heat when brought in contact with water, and that, within certain limits, the amount of heat produced is proportional to the amount of water. The accuracy of the method was checked and found satisfactory. A determination can be made in about 5 minutes.

Effect of Drouth on Soluble Nitrogen and Phosphate Phosphorus in the Conducting Tissues of Snap-beans. Beans growing in soil that contained enough moisture to permit fairly normal growth were compared with those growing on adjacent soil that were severely stunted by drouth but not wilted. It was found that the stunted plants contained much larger percentage of soluble nitrogen than the unstunted ones, and the unstunted plants, a larger percentage of phosphate phosphorus, despite the greater requirement for phosphorus in growing plants than in the stunted ones. This seems to indicate that the stunted plants were unable to utilize nitrogen in growth processes when the water supply was inadequate and that absorption of phosphorus from the soil was checked. After a rainfall of about ½ inch the stunted plants started to grow

but a week later the soil seemed to be as dry as it had been before the shower. At this time it was found that the soluble nitrogen relationship between the two lots was about the same as before, but the percentage of phosphate phosphorus in the stunted plants was much smaller while that in the unstunted plants remained unchanged.

It would appear that the brief stimulus to growth provided by the shower resulted in the utilization of the phosphorus present in the stunted plants, and because new increments of phosphorus were not absorbed from the soil, the amount in the lower conducting tissues was low. If this explanation is correct, it would appear that reduced availability of soil phosphorus during a drouth may be a cause of stunted growth during the time that the soil moisture is low but still above the wilting point.

Method of Planting Lima Beans. In the absence of data to show the advantage of planting seeds in a certain position in comparison with those sown in the usual hit and miss manner, two rows 200 feet long were planted with the large-seeded Fordhook lima beans from one lot of seed. In one row the seeds were all placed with the eye down and in the other they were allowed to lie as they fell when sown. The seeds were covered with one inch of soil. The stand in the row with seeds placed eye down was 375 plants, in the other row, 200. Placing each bean requires more labor but when planting is done by hand the extra cost of labor may be offset by the saving in amount of seed required.

Control of May Beetles. May beetles, the adults of white grubs, injured oak and walnut foliage thruout the Bluegrass in the spring of 1936. During the flight season 11,601 beetles belonging to 11 species were collected. The most common kinds were *Phyllophaga hirticula, hornii, tristis, futilis, bipartita* and *inversa.* Specimens of *P. rugosa, fusca, fervida, ephilida* and one species thought to be undescribed were also taken. *P. fraterna* was dug from the soil in the fall.

Species abundant in some localities were scarce or absent in others. Spring flight periods and preferred host plants also differed. *P. hirticula* was mainly responsible for the stripping of oaks in the Lexington vicinity. While elm and hackberry were favorite food plants of *P. futilis,* they suffered little in-

jury as they were ignored by the more prevalent *P. hirticula*.

A light trap set at or near the base of each tree, and operated from 7:30 to 9:30 o'clock on warm nights the first two weeks of May, lessened beetle damage to individual trees. Where larger numbers of trees were involved, spraying with a heavy dosage of lead arsenate was of value, as some beetles were killed, others repelled by the spray and still others partially poisoned and destroyed by birds.

Soil Insecticides. Tests of various emulsifiers and ways of emulsifying kerosene, carbon disulfide and orthodichlorobenzene for use as soil insecticides to control white grubs were made. Kerosene and carbon disulfide could not be emulsified properly with common emulsifiers such as fish oil soap or laundry soap unless combined with the hot, diluted emulsifier by pumping. Orthodichlorobenzene was the easiest to emulsify. Very stable emulsions were made without pumping, using fish oil soap or fish oil soap plus isoamyl alcohol. The best method of preparing stable emulsions of any of the materials was by the use of miscible emulsifiers previously developed at this Station. In laboratory tests with second-stage *Ochrisidia immaculata* and green June beetle larvae, orthodichlorobenzene and carbon disulfide, 0.5% emulsion killed 93 percent and 100 percent of the Ochrisidia and 100 percent of the green June beetle larvae.

Grub Survey. In a survey of fields near Berea, Winchester, Clintonville, Minersville, Jonesville, Nicholasville, Versailles and Lexington, grubs or grub remains were found in all except one. It appears that the large number of May beetles in flight during the spring of 1936 could not reestablish themselves in pastures. Little damage may be expected in these areas in 1937, as most of the grubs present in the soil are full-grown, at which stage they do little harm.

Dormant Treatments for Aphis Control in Orchards. Plans to test promising dormant treatments for the rosy apple aphid had to be delayed, as no rosy aphids were found in the spring of 1936 tho apple-grain aphids were abundant. On the two check plots treated with lime-sulfur 1 to 8, 47.5 percent and 54 percent of the fruiting clusters were infested with apple-grain aphids. On three plots treated with pine tar oil-bordeaux-soap, spray oil-caseinate, and lime-sulfur 1 to 8 plus nicotine

sulfate 1 to 800, the respective results in percentage of infestation of fruiting clusters was found to be 20, 15.5, and 16 percent. A plot treated with coal tar oil-bordeaux-soap had the lightest infestation of 6 percent.

Trapping Green June Beetles. It was found that green June beetles, which are injurious to ripe apples, peaches and grapes, were attracted by a fermenting bait of honey, 5 percent, dark molasses, 5 percent, and water, 90 percent. More than 7,500 were captured in a few bait pans in the Experiment Station orchard. Traps suspended in trees, fairly high off the ground, caught the most beetles.. A group caught July 11 contained 365 males and 105 females; a catch taken July 15 was made up of 425 males and 435 females.

Controlling Red Spider on Raspberry. Replicated plots were laid out on the Station farm in a red raspberry patch heavily infested with red spider. Each plot was replicated six times. Both sulfur dust 300-mesh and wettable sulfur 1-100 plus glue 5-100 caused severe foilage injury and leaf drop, bearing out observations that raspberries are sensitive to sulfur in any form. No foliage injury occurred on the plots treated with one percent of summer oil, and the new foliage was of a fine dark green color. Three treatments at six-day intervals reduced the number of red spiders by 92 percent, compared with the check plots.

Relation of the Pea Aphid, Illinoia pisi Kolt, to Clover and Alfalfa Failure. Clover and alfalfa were injured by drouth and hot weather, so that they were not inviting as host plants for the pea aphid. Kentucky 101, Minnesota 4, Louisiana 29070 and Idaho 7 clovers were used in some preliminary tests to determine the effect of the aphid, which was confined on these clovers for different lengths of time. The Idaho and Minnesota clovers were more severely injured than the Kentucky and Louisiana. The Kentucky and Louisiana clovers seemed to be injured approximately to the same degree, but further tests will be necessary.

Poisoned Bran Bait. While poisoned bran bait is sometimes used to control the green June beetle larvae in tobacco beds, with a dosage of 4 pounds dry weight to 100 square yards of bed, yet tests made this fall with 4, 5 and 6 pound dosages per 100 square yards of bed failed to give adequate control. The

6-pound dosage killed 40 to 65 percent of the larvae. The 4, 5, and 6 pound dry weights are equal to about 9½, 12 and 14 pounds of moist bait. The bait was composed of 25 pounds of bran, 1 pound of paris green, and water to moisten.

Phony Peach. Inspection was continued in cooperation with the Bureau of Entomology and Plant Quarantine of the United States Department of Agriculture. Activities centered in the western part of the state, as winter injury to trees in central and eastern Kentucky made identification of the disease difficult. One infected tree was found in McCracken county.

Nursery Inspection. One hundred seventy-six regular inspections of nursery stock were made. Of these 68 were of general nursery stock, 46 of sweetpotato plants in beds, 40 of strawberry plants, 14 of perennials, bulbs, etc. The remainder were made up of fruit stock, raspberry plants, sweetpotato plants in storage and tomato plants. During the year, 79 resident nurserymens' certificates, 125 non-resident nurserymens' certificates, 151 nursery dealers' permits and 31 nursery agents' permits were issued.

Feed Control. Because of the drouth and the return to more normal economic conditions, there was marked increase in the volume of feedstuffs sold in Kentucky during 1936. It is estimated that more than 325,000 tons of feedstuffs were consumed, which is an increase over 1935 consumption of more than 125,000 tons.

The heavy demand and high prices created much unscrupulous competition. Manufacturers who adulterated and misbranded their feeds were required to withdraw a large tonnage of such feeds from Kentucky markets. In several instances, it was necessary not only to prosecute but to require the withdrawal of feeds and to cancel registrations. The manufacturer misbranding feeds who was allowed to continue was placed on probation, and his sale of feeds was contingent upon his compliance with the law in the future. In instances of persistent and continued violations, the registrations were cancelled and violating manufacturers were denied the privilege of shipping feeds into the state.

A study of canned dog feeds was continued with the aim of establishing a minimum standard for such feeds. Sixty-

seven official samples of dog feeds were collected. The samples varied from 4.8 to 12.5 percent protein, from .5 to 6 percent fat and from .5 to 4 percent fiber. The water content, most of which was added, varied from 65 to 85 percent. Calculated on an average cost of 6 cents a can for some of the cheapest canned dog feeds, and not considering the cheapness and questionable character of the contents of some of these feeds or cost of the containers, the total possible nutrients would be worth only 0.9 cents a can while the water content would cost 5.1 cents; or, 2.4 ounces of nutrients at a cost of 6 cents; 1 pound, 40 cents; 100 pounds $40.00; one ton $800.

The use of filler feeds in the state was of more concern than in previous years. Kentucky is the only state which by regulation limits the use of fillers to 25 percent of the mixture. Cheap and trashy filler feeds which do not meet the standards are not permitted to be sold in this state. To increase the quality and to meet the standards required, the value of such feeds must be raised from $2 to $4 a ton.

Synthetic hominy feeds have been the subject of considerable study and attention. Small corn mills within this state and in the surrounding states have been making synthetic hominy feed which is a blend of different ingredients, often of inferior quality. These mills have been selling this synthetic feed in competition with bona fide hominy meals. Also large and controlling corn mills of the industry combined illegally, it seems, to force a lower standard, to produce quantity by increasing the filler and thus lowering the quality. To cope with the situation, sufficiently high minimum standards were adopted in order to prevent the use of cheap and inferior products in these feeds. By this means a reasonably high quality of hominy feeds was maintained.

An effort was made to keep the distillers dried grains offered for sale in the state on a high standard, free of adulteration and misbranding. The manufacturers gave fine cooperation to this end. Approximately 90 thousand tons of this supplement feed, high in quality and digestibility, and economical in feed value, are produced annually in Kentucky. However, the bulk of this output is shipped to other states where it seems to be in greater demand than in this state.

For the year, 1402 samples of commercial feeds were an-

alyzed, chemically and microscopically, many of them for complete analysis. Of this number, 964 were official samples for check anaylsis against the guaranties of manufacturers; the remaining 438 samples were analyzed for feeders, dealers, investigational work in the department of feed control and other departments of the Experiment Station, and for Federal and State feed officials and cooperative projects.

Fifteen suits for violations of the law were filed in the state courts, resulting in judicial decisions for the department of feed control. In addition 45 registrations of brands of feeds and right to ship these feeds into the state, representing 12 companies, were cancelled because of adulteration and misbranding. This action resulted in the removal from the market of a large tonnage of feed. After making proper adjustments, taking feeds off the market, changing formulas, making refunds and assurance of future compliance with the law, most of these companies were reinstated and placed on probation, contingent on their cooperation and future conduct of their business in the state.

Fertilizer Control. Registration of fertilizers showed 634 different brands offered for sale in the state. Samples for analysis collected by inspectors and sent in by farmers numbered 683. A total of 2,022,000 tags were issued to the various firms carrying on business in the state.

Public Service Laboratories. One hundred and seventy-nine thousand, seven hundred and thirty examinations were made in the public service laboratories. Of this number 178,663 were handled in the bacteriological laboratory and covered examinations for infectious and contagious diseases, sanitary examinations of water and milk and of food products for sanitary quality or spoilage, etc. A very important work of the laboratories is the sterilizing, assembling, labelling and shipping of specimen-containers for use by physicians, hospitals and county health departments. The number of containers prepared and sent out was 98,144.

Approximately 40 percent of the work in the food laboratory was on official samples received from the Bureau of Foods, Drugs and Hotels, and consisted of a wide variety of food products difficult of classification, owing to the submission of only one or two samples of a kind for examination.

The samples submitted required 768 examinations, including food products requiring special investigation.

Much of the work referred to the drug laboratory is for the purpose of determining the cause of death of humans and animals, or for the analysis of a wide variety of materials suspected of containing poison of some nature. Frequently these cases require the collaboration of the chemist and bacteriologist before a solution of the problem can be found, as from the data available in many of the cases it is difficult to determine whether chemical poisoning or one of a bacterial nature is responsible, especially in cases of mass poisoning where food eaten is under suspicion.

Creamery License. Eleven hundred and thirty-nine inspections and 20,716 individual tests were made under the creamery and tester's license law. From findings of these inspections the operators were graded as follows: A, B or C, 851; D (probation) 240; E (to be called before the Examining Board) 48. A comparatively large number of re-inspections were made in order to eliminate unsatisfactory testing as nearly as possible. In many instances an improvement was noted on second inspection. Testing equipment calibrated for accuracy numbered 24,903 pieces of which 71 pieces were rejected, also 89 nine-gram weights, 4 test scales, 4 centrifuges, 1 platform scale, 4 dividers were condemned and 61 illegal test bottles were confiscated.

The Examining Board considered the cases of 48 operators because of inaccurate testing and violation of regulations. The licenses of 24 were revoked, 20 were placed on strict probation with provision for revocation of license if future inspections were not satisfactory, and one request for reinstatement was denied. The cases of three operators are pending.

License to buy milk and cream on the butterfat basis was issued to 10 creameries, 13 cheese factories, 6 condenseries, 51 milk plants, 44 independent operators of cream stations and 1256 cream stations operated by creameries. These total 1380, of which 1314 were renewals and 66 new buying places in operation since June 30,1936. Permits in lieu of license to test, pending examination and now in force, were issued to 47 operators of the Babcock test; new licenses were issued to 277 applicants and renewal licenses to 1123 operators, all of

which expire June 30, 1937. Forty examinations for applicants for license to test were held at the following places: Lexington, 5, Louisville, 5, Bowling Green, 5, Owensboro, 4, Mayfield, 5, Maysville, 2, Walton, 1, Marion, 1, specials, 12. Notification of examination was sent to 799 operators; 443 reported, of whom 58 or 13 percent failed to make a passing grade.

The receipts for the year were $12,654.30 and the expenditures $14,982.69, as itemized:

Salaries	$10,209.07
Labor	1,641.85
Postage and stationery	405.89
Freight and express	30.90
Sundry and laboratory supplies	260.42
Travel	2,347.86
Publications	64.77
Heat, light, water, power	21.93
	$14,982.69

Seed Inspection and Analysis. Records of tag sales indicate a normal movement of seeds the first seven months of the year, and unusual activity during August, September and October. The number of samples received for examination was 3,943. Purity tests were made upon 1,984 samples, and 3,322 samples were germinated. Of the samples tested, 593 were of grasses, 1,425 of clovers, 14 of vegetables, 996 of large seeds, 704 of tobacco and 211 of collectors' samples. In addition, 1,112 pounds of tobacco seed were cleaned. There was an exceptional cooperation on the part of the seedsmen in aiding the enforcement agencies to carry out the provisions of the seed law. Only one case was filed in court.

Nursery Inspection. Despite relatively heavy losses to nursery stock because of the hot, dry weather, increased sales and prices of stocks during 1935 and 1936 encouraged nurserymen. Most of the overgrown stock accumulated from 1930 to 1933 has been moved. The spirit of cooperation between nurserymen and inspection officials was helpful, as is evidenced by the fact that it was not necessary to make any prosecutions under the nursery law.

ROBINSON SUBSTATION

Forestry. The work of the Civilian Conservation Corps was started at the Robinson forest at Noble, Ky., in June of 1933

and discontinued during the latter half of 1936. The tract is to be a demonstration forest; that is, to illustrate results of intensive forest management, and permit experiments in factors relating to forestry. Included in this are orderly removal of timber and timber products, methods of "mixed forest" culture, preservation of wild life, recreational facilities for the public, and providing labor for adjacent communities in management, removal and manufacture of timber products. Developments at the Robinson forest may have a bearing on the use of approximately several million acres of land primarily in forests in eastern Kentucky. This program makes necessary rather extensive roads, fire lookouts, firebreaks along ridges at points susceptible to outside fires, and foot trails. Otherwise, fires and other disasters may destroy a forest at the outset.

Continuing work already begun, the Civilian Conservation Corps had by March 31, 1936, completed 22½ miles of truck trails of which 17½ served families of nearby communities as well as the forest; small picnic grounds were developed, with fireplaces, tables and other facilities; 560 acres of forest stand improved and fire hazard reduced; 15 miles of firebreaks constructed; 40 acres tree plantations established; 14 miles of foot trails made; 1,036 lineal feet of bridges made as part of the truck trails; 3 low-water bridges made as part of the truck trails, and a 100′ steel lookout tower built.

The policy is being pursued of fighting fires with only the regular personnel as far as possible. The presence of the CCC gave impetus to this plan. In the past year there were 27 fires covering 203 acres.

A total of 5,000 black locust and 2,500 red oak plantings were made. Apparently because of the very hot, dry, early summer, "slip" plants were an almost complete failure. Experimental plantings included 30 hybrid chestnuts sent by the U. S. Bureau of Plant Industry, but the plants had been too long in shipment to live.

Laying Mash for Chicks. The effects of feeding a laying mash from hatching time to maturity were observed with two lots of Rhode Island Reds and two lots of Barred Rocks. From two years' results it appears that a laying mash containing the essential nutrients in suitable proportions can be

fed chicks from the start with no undesirable effects on subsequent egg production (see table).

Production of Chicks Grown on Chick Mash and Laying Mash.

	Barred Rocks		Rhode Island Reds	
	Winter	Year	Winter	Year
1934-1935				
Grown on chick mash and grain	43	158	41	160
Grown on laying mash and grain	49	163	43	159
1935-1936				
Grown on chick mash and grain	37	161	34	147
Grown on laying mash and grain	31	140	43	169

Farming. Yields were affected by the drouth. The bulk of the corn raised in 1936 was sound and of good quality, tho the 1935 crop was sappy and of low grade. White corn yielded 50 to 60 bushels, and yellow corn 40 to 50 bushels. Hay acreage was smaller than usual, and drouth cut the yield. The orchard fruit crop was a failure; strawberries and grapes produced satisfactory yields. Farmers who brought in feed corn were given tested seed corn in exchange.

Meetings. Many meetings were held at the Substation during the year. They included a leaders' conference, camp for farm women, 4-H club camp, the 11th annual Robinson Harvest Festival, and the Regional Conference for Southern Mountain Workers.

WESTERN KENTUCKY SUBSTATION

Pasture Experiments. Grazing of the experimental pastures began on May 1 and continued for 153 days. The untreated pasture carried an average of 2.6 steers per acre during the season. The animals made a total gain in weight of 43 pounds per acre. The rock phosphate treated field carried 6.8 steers per acre, and they increased in weight at the rate of 169 pounds per acre. Respective data for the limestone-superphosphate treated field are 7.6 steers per acre and an increase in weight of 167 pounds per acre.

The flora of each field at the end of the season apparently was similar to that of recent years, tho it was impossible to determine the extent to which the drouth had changed the proportions of the various species. Buttonweed (*Diodia teres*), ragweed (*Ambrosia bidentata*), poverty grass (*Aristida*

dichotoma), panicums, and sassafras and persimmon shrubs were dominant species on the least fertile areas of the untreated field. On the somewhat more fertile areas, field daisies (*Chrysanthemum leucanthemum*) were abundant also. In the bottom of the draw, broom sedge (*Andropogon virginicus*) had almost crowded out all other species. Plants of Korean and common lespedeza—mostly the latter—were plentiful early, but made only one or two inches of growth and most of them died during the summer because of the severe drouth. A fair stand of weak redtop adds to the herbage on the areas of intermediate fertility; it has about disappeared from the bottom of the draw where the most fertile soil of this field is, because of broom sedge infestation.

It appears that the grasses, especially orchard grass, redtop, Canadian bluegrass and Kentucky bluegrass, are becoming more vigorous in the rock phosphate treated field, and therefore that a good sod may develop in time, despite the present almost complete covering of sour dock (*Rumex acetosella*) and field daisies, and large amounts of yarrow (*Achillea millefolium*) and broom sedge.

The flora of the limestone-superphosphate treated field was principally orchard grass, Canadian bluegrass and Kentucky bluegrass, with a goodly number of small common and Korean lespedeza plants. White clover was abundant early in the season. Sour dock and broom sedge are slowly becoming more abundant. However, the difference between this field and the rock phosphate treated field in proportion of weeds to pasture plants makes a striking demonstration of the effectiveness of good sod in weed control in permanent pastures.

Because of the large growth of broom sedge, many of the small fertilizer plots originally seeded to a mixture of many pasture plant species were plowed and planted to corn last spring. The average yield of the untreated check plots was 7.5 bushels per acre. The plot treated with 2 tons of limestone, 1000 pounds of 16 percent superphosphate, and 18 tons of manure since the beginning of the experiment in 1928 produced a corrected yield of 33 bushels per acre. Corn in a corn-wheat-clover rotation fertilizer experiment, located close by on the same type of soil, produced an average yield of 8.9 bushels per acre, on the check plots, which had been treated

with 12 tons of manure per acre since the experiment was started in 1929. On the plot since 1929 had received 12 tons of manure, 1400 pounds of 16 percent superphosphate, and 2 tons of limestone per acre, the average corrected corn yield was 24.8 bushels per acre. These differences and others of like significance on plots similarly treated indicate the effectiveness of pastures in soil building and conservation.

Red Clover Tests. Adapted Kentucky clovers produced an average of 5,100 pounds of barn hay per acre from the first cutting. Clover from northwestern states produced 3,500 pounds.

Soil Management Studies. The projects in soil management were continued, with results in harmony with those previously reported. A project of particular interest is the test of the effect of various legumes and grasses as the third-year crop in a three-year rotation with corn and wheat. A bulletin is in preparation giving the results.

An experiment on the soil of sandstone origin was started in 1929 with a three-year rotation of corn, wheat, and mixed clover, lespedeza and timothy hay. Manure was used for corn on all plots at the rate of 5 tons an acre from 1933 to 1935; since then, manure has been applied for corn at a rate equal to the crops removed, except wheat grain. The experiments show that limestone and phosphate are the treatments most needed for this soil; limestone was applied at the rate of 2 tons an acre in the beginning of the experiment, and 16 percent superphosphate at an average annual rate of 200 pounds. Average acre yields for the limestone and superphosphate plots and for check plots are given below:

	No Limestone or Phosphate	Limestone Superphosphate
Corn, average 7 crops	21.6 bus.	38.3 bus.
Wheat, average 7 crops	2.9 "	12.0 "
Hay, average 6 crops	1256.0 lbs.	3488.0 lbs.

Curing Dark-Fired Tobacco. Tests were conducted with fired tobacco to make a comparison of the so-called "soft cure" of fired tobacco and the "old method" of curing in which higher temperatures and lower humidities are used. Methods of heating, ventilating and humidifying the air to find the most practical ways of inducing optimum curing of dark tobacco

were also studied. The barn used for tests was divided into two sections and the walls made practically air-tight by using paper on the interior surface. The new type of ridge ventilator was provided to control the air circulation.

The observations on the construction of the present tobacco barn and ventilation system used this year indicate that it is advisable to have a tight barn provided with carefully fitted inlet and outlet ventilating doors to control the circulation of air. It was found that when outside temperature and humidity are low, it is advisable to provide additional circulation of air thru the barn by opening the entrance doors or provide heat, if the humidity and temperature desirable during the yellowing stage of the curing process are to be maintained. The information gathered this year during the other stages of curing shows that it is possible by the firing methods generally practiced at present to control the temperatures fairly closely within the desired range. However, it is almost impossible to maintain the recommended humidities by the practice of sprinkling water on the floor and adding it to the sawdust. This indicates that it may be desirable to provide additional ways of adding moisture at certain stages of the curing process.

The records show that the loss of weight of the tobacco on the weighing racks in both sides of the barn during the curing period was practically the same, being 81.4% on the "modified old cure" side and 81.8% on the "soft cure" side. The difference is not significant.

During the firing season, 4,115 pounds of sawdust and 1.25 cords of wood in the form of slabs and chunks were used per 1000 pounds of cured tobacco in the "old cure" and 3,150 pounds of sawdust and 0.76 cords of wood for the "soft cure". Six hundred thirty-one gallons of water per thousand pounds of cured tobacco were required in soft curing.

The tobacco produced by both methods of curing was of high quality and commanded a high average price. The leaf brought $27.00 per hundred, the lugs $12.00 and the trash $6.00. The average price obtained for the leaf grade cured by the old methods was slightly more than the price of the "soft cured" leaf, but the difference was not significant. This indicates that the temperature and humidity ranges that give

satisfactory results in curing fired tobacco are probably greater than has been generally believed. As already stated the temperature and humidity maintained in the so-called "old cure" in this experiment were not typical of the practices generally recommended in the past, in which much higher temperature was used with lower humidity because the barn was not tight. The information obtained from this year's investigations is not of sufficient significance to warrant any conclusion as to which method is the better.

Soil Erosion. This project was started in 1926 to show the effectiveness of terraces and stake and brush dams in the control of erosion. A 6-year crop rotation was completed this year. In the treated part of the area, erosion was largely prevented and there is appreciable improvement even in the untreated part, probably brought about by the crop rotation.

Orchard Drainage. Subzero temperatures and heavy frosts killed most of the fruit buds. Trees were vigorous in appearance, with heavy, dark foliage. There is little apparent difference in the trees of the various plots. So far, no definite conclusions can be drawn as to the benefit of tile drainage.

Apples. The plot with summer cultivation and a winter cover of rye and vetch continued to produce better tree growth than those in permanent sweet clover and permanent lespedeza. The trunk circumference of the trees averaged 2.6 inches greater in the cultivated plot than in the other plots. The trees also have had greater spur growth in the cultivated plot than in the others. Fruit yields were 57 bushels for the cultivated plot, 24.7 bushels for the sweet clover plot and 12 bushels for the lespedeza plot.

Meetings. Annual meetings held during the year were the Fifth Annual Short Course, the 4-H Club leaders' conference, two 4-H Club camps, and the annual field day meeting. The short course had a daily attendance of approximately 235, while the field day meeting attracted more than 1,000 persons.

NEW PROJECTS

Relative yields of grasses grown in Western Kentucky.

A study of firming of fat in carcasses of hogs fed distillery slop and corn.

Investigations on parasites of the oriental fruit moth with particular reference to colonization and recovery work in Kentucky.

A study of the relation of the pea aphid (Illinoia pisi Kolt) to clover and alfalfa failure.

Pasture experiments.

Investigation of nitrogen and phosphorus in apple trees.

A study of income parity for agriculture.

The relationship of certain constituents of egg yolks to hemoglobin regeneration in humans and to embryo mortality in the hen's egg.

The effects on reproduction, fleshing qualities, and consumer demand of factors affecting rate of growth in chicks.

A study of incubation environment and certain chemical factors influencing embryo mortality, embryo growth and hatchability.

PUBLICATIONS

Bulletins:

No. 355. (Reprinting). Farm taxes and local government in Livingston and Crittenden Counties, Kentucky. T. B. Manney, B. W. Allin and C. J. Bradley. January, 1936.

No. 362. (No. 328 revised). Tobacco diseases. W. D. Valleau and E. M. Johnson. March, 1936.

No. 363. The effect of cod liver oil in the diet of the mother hen, on embryo mortality and on the calcium and phosphorus content of the embryo. W. M. Insko, Jr., and Malcolm Lyons. June, 1936.

No. 364. Factors in the success of rural organizations. Fred Boyd, Merton Oyler and W. D. Nicholls. September, 1936.

No. 365. Part-time farming by negroes near Lexington, Kentucky. Merton Oyler, W. W. Rose and W. D. Nicholls. November, 1936.

No. 366. Community and neighborhood groupings in Knott County. Merton Oyler. November, 1936.

No. 367. The seasonal course of soluble nitrogen and phosphate phosphorus in the shoot growth of Winesap apple and Elberta peach. C. S. Waltman. October, 1936.

Station Circulars:

No. 44. A leafhopper pest of clover and alfalfa. H. H. Jewett. April, 1936.

No. 45. Aphids. W. A. Price. May, 1936.

Regulatory Series Bulletins:

No. 4. (Revised). The Kentucky Seed Law. W. A. Price. April, 1936.

No. 9. Testing cream and milk for butterfat. J. D. Foster. July, 1936.

No. 10. Commercial feeds in Kentucky in 1935. J. D. Turner, H. D. Spears, W. G. Terrell and L. V. Amburgey. July, 1936.

Pamphlet:

Some facts concerning the feeding stuffs law of Kentucky and suggestions to the feeder and manufacturer. J. D. Turner. September, 1936.

Annual Reports:

47th Annual Report of the Station, Part II. Thomas Cooper.

48th Annual Report of the Station, Part I. Report of the Director for 1935. Thomas Cooper.

48th Annual Report of the Station, Part II. Thomas Cooper.

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A method for describing strains of tobacco mosaic virus. W. D. Valleau. Phytopath. 26: 111. Feb., 1936. Abstr.

Are tobacco plants affected with mild mosaic susceptible to other strains of the virus? E. M. Johnson and W. D. Valleau. Phytopath. 26: 96. Feb., 1936.

Physalis subglabrata: a natural host of Bacterium angulatum. W. D. Valleau and E. M. Johnson. Phytopathology 26: 388-390, 1936.

The effect of certain management practices on the amount of nitrogen in the soil. P. E. Karraker. Jour. Amer. Soc. Agron. 28: 292–296, 1936.

Kentucky bluegrass as a source of vitamin D and protein for growing chicks. G. Davis Buckner, W. M. Insko, Jr., and J. Holmes Martin. Read before the 6th World Poultry Congress, Leipzig, Germany, July 27, 1936, and published in the Proceedings, Vol. I, Sec. 2, p. 240.

Chemical analysis and probable cause of urinary calculi formed in a four-year-old bull. G. Davis Buckner and E. S. Good. Read before the 23rd annual meeting of the Kentucky Academy of Science, Bowling Green, Ky., May 9, 1936.

Distillers' dried grains and distillery slop in chick rations. G. Davis Buckner, W. M. Insko, Jr., J. Holmes Martin and Amanda Harms. Read before the 23rd annual meeting of the Kentucky Academy of Science, Bowling Green, Ky., May 9, 1936.

Make worn out land pay in pasture for beef cattle. E. S. Good. Read before the 29th annual meeting of The American Society of Animal Production, Chicago, Ill., Nov. 27-28, 1936, and published in the Proceedings, pp. 56–60. December, 1936.

The occurrence of milk fever in the Kentucky Station herd over a period of 20 years. H. J. Metzger and H. B. Morrison. Presented at the 29th annual meeting of The American Society of Animal Production, Chicago, Ill., Nov. 27–28, 1936, and published in the Proceedings, pp. 48–52. December, 1936.

Another death from electric shock. H. J. Metzger. Cornell Veterinarian 26: 341. Oct., 1936.

Chemical analyses of Fayette County Soils, by O. M. Shedd. In Soil Survey of Fayette County, Kentucky, by H. M. Higbee, U. S. D. A., and K. S. Venable, K. A. E. S. Bureau of Chemistry and Soils in Cooperation with the Kentucky Agricultural Experiment Station. Series 1931. No. 25, pp. 38 (1936).

Agricultural methods and management. P. E. Karraker. Same, pp. 27–31.

Methods for the determination of iodine in soil. J. S. McHargue and D. W. Young. Jour. Asso. Off. Ag'l. Chemists, Vol. 19: 66–68. Feb., 1936.

Report on less common elements in soil. J. S. McHargue and D. W. Young. Jour. Assoc. Off. Ag'l. Chemists, Vol. 19, pp. 264–268. May, 1936.

Report on less common metals in plants. J. S. McHargue. Jour. Assoc. Off. Ag'l. Chemists, Vol. 19, pp. 365–366. August, 1936.

Report on methods for the determination of iodine in soil. J. S. McHargue. Presented at the meeting of the Assoc. of Off. Agr. Chemists, Washington, D. C., Nov. 11–14, 1935. Jour. Asso. Agr. Chemists, Vol. 19, pp. 66–68. Feb., 1936.

The effect of arsenic on the growth of rats and chickens and the distribution of this element in the tissues. J. S. McHargue and Malcolm Lyons. Presented before the Chemical Section of the Kentucky Academy of Science at the annual meeting in Bowling Green, May 8–9, 1936.

A polarizing attachment for the spectroscopic determination of boron. J. S. McHargue and R. K. Calfee. Presented before the Chemical Section of the Kentucky Academy of Science at the annual meeting in Bowling Green, May 8–9, 1936.

The necessity of some minor elements in the economy of plants and animals. J. S. McHargue. Presidential address read at the 23rd annual meeting of the Kentucky Academy of Science, May 8-9, 1936, at Bowling Green, Ky.

The necessity of minor elements for the growth of tomatoes in a poor soil. J. S. McHargue and R. K. Calfee. Presented before the Division of Fertilizer Chemistry of the American Chemical Society at the meeting in Pittsburgh, Pa., Sept., 1936.

Report on minor elements in soils. J. S. McHargue and W. T. Forsee. Presented at the annual meeting of the Association of Official Agricultural Chemists, Washington, D. C., by the Referee on Soils, Dr. W. H. MacIntire, Nov. 30 to Dec. 2, 1936.

Miscible oil emulsifiers and spreaders. C. O. Eddy. Presented at the meeting of the Amer. Asso. of Economic Entomologists. Jour. Econ. Entomology, 29:722-725, 1936.

New developments in adhesive spreaders. C. O. Eddy. Trans. Ky. State Hort. Soc., for 1935, pp. 140–145.

General insect control. C. O. Eddy. Trans. Ky. State Hort. Soc. for 1935, pp. 145–150.

Nut trees for landscape planting. N. R. Elliott. Trans. Ky. State Hort. Soc., 1935, pp. 102-104.

Distillery slop as a feed for hogs. E. J. Wilford. Read before the 29th annual meeting of The American Society of Animal Production, Chicago, Ill., Nov. 27–28, 1936, and published in the Proceedings, pp. 106-110. Dec., 1936.

Egg weight and hatchability in turkey eggs. J. Holmes Martin and W. M. Insko, Jr. Presented at the 28th annual meeting of the Poultry Science Association, August 4–7, 1936.

Antigenic relationships of Salmonella aertrycke, var. binns. P. R. Edwards. Presented at the meeting of the Soc. of Amer. Bacteriologists in New York City, Dec. 26-28, 1935. Abstr. in Jour. Bact., Vol. 31: 43, 1936.

Fermentative varieties of Salmonella aertrycke. P. R. Edwards. Jour. Infec. Diseases 58: 225–229, May-June, 1936.

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Occurrence of Salmonella, Oranienburg type, in an infection of quail. P. R. Edwards. Jour. of Bacteriology, Vol. 32, No. 3, Sept., 1936.

Intravenous medication. H. J. Metzger. Presented at the annual meeting of the Ky. Vet. Med. Assn., July 15, 1936.

A case of tetany with hypomagnesemia in a dairy cow. H. J. Metzger. Cornell Veterinarian 26: 353-356, October, 1936.

The clinical examination of brood mares for pregnancy. W. W. Dimock. Cornell Veterinarian 26: 314-323, October, 1936.

Equine abortion. W. W. Dimock and P. R. Edwards. July, 1936. To be published in the Proceedings of the Ky. Vet. Med. Assn.

The differential diagnosis of equine abortion with special reference to a hitherto undescribed form of epizootic abortion of mares. W. W. Dimock and P. R. Edwards. The Cornell Veterinarian 26: 231–240, July, 1936.

Paratyphoid infection of fowls. Philip R. Edwards. Presented at the 40th annual meeting of the U. S. Live Stock Sanitary Ass'n., at Chicago, Ill., Dec. 2, 3 and 4, 1936, and published in the Proceedings, page 403. 1936.

The use of silica dishes in the present official method for potash in fertilizers. H. R. Allen and Lelah Gault. Presented at the annual convention of the Assoc. of Official Agricultural Chemists, Washington, D. C., November, 1936.

The correlation of soluble nitrogen and phosphate phosphorus in the conducting tissue of potatoes at various stages of growth, with yield. E. M. Emmert. Proc. Amer. Hort. Soc., Vol. 33: 589-594.

Effect of drouth on the nutrient levels in the tomato plant. E. M. Emmert. Soil Science, Vol. 41: 67–70. Jan., 1936.

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FINANCIAL STATEMENT

In Account with the United States Appropriations, 1936

	Hatch Fund	Adams Fund	Purnell Fund	Bankhead–Jones	Bankhead–Jones Offset
Receipts:					
From the Treasury of the United States, as per appropriations for fiscal year ended June 30, 1936	$15,000.00	$15,000.00	$60,000.00	$19,734.51	
From sources within the State as Bankhead-Jones offset					$20,128.16
Expenditures:					
Personal services	14,396.52	14,465.74	53,449.15	1,133.34	19,948.95
Supplies and materials	28.00	392.62	1,437.03	295.70	171.76
Communication service			72.00		.85
Travel expenses	289.26		2,446.54	184.21	
Transportation of things		2.98	25.49		
Printing and illustrating publications	218.50		1,984.97		
Heat, light, water and power		30.43	32.49		
Contingent expenses	25.00				
Equipment	42.72	108.23	552.33	626.26	6.60
Buildings and land				17,495.00	
Total	$15,000.00	$15,000.00	$60,000.00	$19,734.51	$20,128.16

We, the undersigned, duly appointed auditors of the expenditures, from Federal appropriations and Bankhead-Jones offset Funds reported herein, do hereby certify that we have examined the books and accounts of the Kentucky Agricultural Experiment Station for the fiscal year ended June 30, 1936; that we have found the same well kept and classified as above; and that the balances, receipts and disbursements are as follows:

	Hatch	Adams	Purnell	Bankhead-Jones	Total Federal Funds	Bankhead-Jones Offset
Receipts for the year from the Treasurer of the United States	$15,000.00	$15,000.00	$60,000.00	$19,734.51	$109,734.51	
Receipts from sources within the State						$20,128.16
Disbursements for the year	$15,000.00	$15,000.00	$60,000.00	$19,734.51	$109,734.51	$20,128.16
Unexpended balance, June 30, 1936	None	None	None	None	None	None

Proper vouchers for all of the above disbursements are on file and have been examined by us and found correct.

And we further certify that the expenditures have been solely for the purposes set forth in the acts of Congress approved March 2, 1887, March 16, 1906, and February 24, 1925, and June 29, 1935, and in accordance with the terms of said acts, respectively.

Signed:

THOMAS COOPER,
Director of the Experiment Station

D. H. PEAK, Business Agent,
Financial Officer of the Institution

D. H. PEAK,
Secretary of the Governing Board

Attest:

JANE J. NICHOLS,
Custodian of the Seal.